January 13, 1921 American Machinist Vol. 54, No. 2

Wilmarth & Morman Company's No. 78 Surface Grinding Machine

Designed for Ease of Operation—Two Precision Screws Used for Adjusting Wheel to Cut—Clutch and All Gears Run in Oil

SPECIAL CORRESPONDENCE

THE surface grinding machine herewith illustrated and described has been lately brought out by the Wilmarth & Morman Co., Grand Rapids, Mich., and while it is designed to meet the exacting requirements of precision tool and gage grinding it possesses the essential strength and rigidity necessary for intensive production grinding of a diversified range.

In designing this machine particular attention has been paid to the location of all operating controls. It is not necessary for the operator to leave his working position to vertically adjust the wheel-head, to change the amount of cross-feed, or to dress the grinding wheel with the built-in wheel-truing device.

The base is a one-piece casting of sufficient weight and proportion to insure maximum rigidity and stability. The base houses the mechanisms necessary for operating the automatic features of the machine, which are supported on brackets cast integral with the base.

The saddle is supported by two large V-ways which are fully protected by well designed dust guards. Certain details of the longitudinal and cross-feed mechanisms are housed in the saddle.

The table is supported by one V and one flat way and is provided with dust guards and means for carrying off the coolant used in wet grinding. It has a working surface of 6 x 22 in. and has three T-slots, the center one extending beyond the working surface, thus allowing for the clamping of long work or the use of a magnetic chuck.

The longitudinal travel of the table is automatic in both directions, the reversal being controlled by simple adjustable stop dogs. A convenient lever on the saddle controls the starting and stopping of the table, and provision is made for reversing its direction by hand when so desired.

WILMARTH & MORMAN NO. 78 SURFACE GRINDING MACHINE

The automatic transverse travel of the table, in either direction, is controlled by the lever at the right of the base. Adjustable stops limit the transverse travel, which has a range of feeds from 0.015 to 0.1875 in. per stroke.

The wheel-head travels vertically in square ways located on the front and rear sides of the upright housing. A very sensitive takeup for the slightest appreciable wear is provided on the wheel-head.

The vertical adjustment of the wheel-head is accomplished by means of two precision elevating screws having right- and left-hand Acme threads and working in unison with one another. The elevating screws are mounted in adjustable bronze nuts arranged to compensate for all lost motion in the elevating mechanism. All settling of the head while the wheel is in cut is positively eliminated, thus making possible a dependable, accurate setting of the depth of cut from a direct reading of the handwheel on the right-hand side of the base. This handwheel is of large diameter and is graduated by widely spaced markings to 0.0005 in. Its location greatly facilitates the setting of the grinding wheel, as it permits the operator to observe the setting without assuming an awkward or tiresome position, as would be the case if the handwheel was located on the wheel housing. The location of the elevating handwheel is an exclusive feature of this machine.

The spindle is a crucible-steel forging accurately machined and balanced, and is carried in annular combination radial and end-thrust bearings. These bearings are made exclusively for precision grinding machines and are especially tested for concentricity.

The gear box containing the table-travel gears, and the reversing mechanism, is located in the base of the machine. The clutch (which is made from hardened

chrome nickel steel) and all gears in the gear box run in oil. A train of gears connects the gear box to a spiral rack and pinion for driving the table. All parts subject to wear are protected against dust, grit and coolant by especially designed guards and barriers.

The cross-feed screw receives its motion through a friction drum driven from the gear box. The transverse motion can be set to feed in or out at one end or at both ends of the table stroke as desired. By moving the cross-feed control lever (located on the right of the base) to its neutral position the cross-feed screw is left free for hand manipulation. The amount of cross-feed per stroke of table is regulated by an adjustable driving disk and link motion located on the front of the base. Here is also located a sliding pin for controlling the cross-feed at one end or both ends of the table stroke. The cross-feed screw is carried in a double-row self-aligning ball bearing. Two opposed adjustable bronze nuts make it possible to take up all backlash. The two features noted above permit an extremely free working screw. This machine is regularly furnished for wet grinding. The coolant is piped to both sides of the wheel, which insures complete immersion of the work as it engages and leaves the weel. This is a feature of no small importance in successful wet grinding. The pump-pans and piping (except the spray guards) are built into the machine.

The wheel truing device, including a diamond, is part of the regular equipment. A vise particularly designed for use in surface grinding can be furnished to order. The vise has hardened steel jaws 6 in. wide, 1½ in. deep and opening 3 in. The countershaft is equipped with pressed steel hangers, ring-oiling, self-aligining babbitt bearings and a self-oiling loose pulley.

The machine can be arranged for motor drive but not including motor starting equipment. A 5-hp., 1,200 r.p.m. motor is recommended.

An Inexpensive and Effective "Dope" for Bright Parts

BY E. A. DIXIE

A very satisfactory "dope" for bright parts of machinery is made by mixing 80 parts of Chinese wood oil and 20 parts of boiled linseed oil. Both these oils dry with comparative rapidity and the composition made in the above-mentioned proportions after a few hours forms a tough film which effectively precludes moisture.

If the composition becomes too viscous to allow it to be spread properly on the goods it should be thinned with turpentine or if this is not available gasoline may be used.

The parts to which the composition is to be applied should be bright and *clean*. Care should be taken that they are not handled with the fingers as they may deposit moisture which will develop into rust spots under the composition after the parts have been treated.

The composition may be applied with a soft camel's hair brush, a piece of waste or a soft sponge. Where large quantities of bright work are to be protected from rusting they may be put in wire baskets and immersed in the composition. The coated goods should be hung up to dry for several hours preferably in a warm dustless room.

The writer has a micrometer which was coated with the above composition shortly after it was bought, new, about 15 years ago. Except for the slight abrasions one would expect to find in a tool of this sort after such a long period of use the tool is as bright as the day it was bought.

Dope of this sort is often applied merely as a temporary protection, and this composition is equally satisfactory for such purpose as it can readily be removed by washing the parts with turpentine, kerosene or gasoline.

What Is a First-Class Machinist?

BY J. A. RAUGHT

Mr. McHenry's question on page 858, Vol. 53, of the *American Machinist* as to what constitutes a first-class machinist will, no doubt, elicit many and conflicting opinions; for the possibilities in the matter of varying conceptions of the necessary qualifications are probably greater than in the case of that closely allied question that has been the recent subject of discussion; namely, what is a machine tool?

A first-class machinist is a man less often seen than discussed, and quite likely in such discussion each individual has in mind an ideal workman, a composite of several of his acquaintances, possessing the good points of all of them and the bad points of none.

In my opinion a first-class machinist should be proficient and skillful in the manipulation of all the standard machines usually found in the modern small machine shop; which includes the lathe, shaper, planer, drill-press, milling machine, boring mill, etc. He should be able to accomplish well and quickly any job that comes legitimately within the range of such machines; and should any one of them not be available (excepting, perhaps, the lathe) he should be able to perform the operations that are usually allotted to the missing machine in some other way.

He should be proficient in the use of the hammer and cold chisel; file and scraper. He should be able to figure pulley sizes to determine proper speed ratios; also pitches, center-distances, etc., incident to the laying out, turning and finishing of a gear or pair of gears; and, should no milling machine or gear cutter be available, he should be able to lay out tooth forms, make cutting tools, and cut the teeth on shaper or planer.

While it is true that gear cutting is now usually considered a separate trade, it is so closely allied to the machinist's trade that no first-class machinist can afford to be ignorant of its principles.

The first-class machinist must also possess sufficient knowledge of forging and tempering to be able, whenever necessary, to perform these operations without outside aid. He should be able to take the drawings and castings of a machine or fixture and from them construct the finished product. He should be handy with drawing tools himself, and should possess a working knowledge of pattern making and foundry practice. He should be able from study of a broken or defective machine to make the repairs or alterations necessary to put it in service.

Many readers will doubtless look upon this somewhat formidable array as impossible of accomplishment and will throw up their hands in despair, but I am acquainted with men who are capable of doing all these things and more besides, although few, if any, have acquired their knowledge and proficiency without the aid of good books. To become a really first-class machinist requires not less than eighteen years of constant study and experience.

Manganese Steel and Methods of Machining It

By S. A. Hand, ASSOCIATE EDITOR, AMERICAN MACHINIST

Composition of Manganese Steel—Behavior After Casting — Heat Treatment Required—Grinding the Only Method of Machining

MANGANESE steel, an alloy containing from 12 to 14 per cent of manganese, was first made by Hadfield at Sheffield, England, in 1886. This alloy is produced in a converter much in the same manner as bessemer steel. When the molten pig iron is tapped from the cupola into the converter about 12½ per cent of manganese is added and is practically all used up in cleansing the metal during the converting period. After running the metal into the ladle a charge of 80 per cent ferro-manganese is added.

Differing from the usual practice in steel making, the metal is poured—not into ingot molds—but directly into sand molds made from patterns of the articles wanted.

Manganese steel when cooled slowly is exceedingly hard and brittle. It can only be rolled with great difficulty, so that in ingot form it would be of very little use. It can, however, be forged, but only at a very high heat, and even then the process is exceedingly slow and tedious. And forgings are necessarily rough and the surplus metal is costly to remove, so that casting seems to be the only commercial way in which this alloy can be made to take such shapes as are desired.

When shaken out of the sand, small risers and sprues can be broken from the castings with a hammer or sledge, but if too large to yield to such treatment they can be cut off with a gas torch or by means of the electric arc. Casting, too, has its difficulties, for the shrinkage is great—as much as $\frac{5}{16}$ in. per foot—and the patterns must be made so that unequal strains in cooling will be as small as possible, otherwise the casting will be greatly distorted and may be broken.

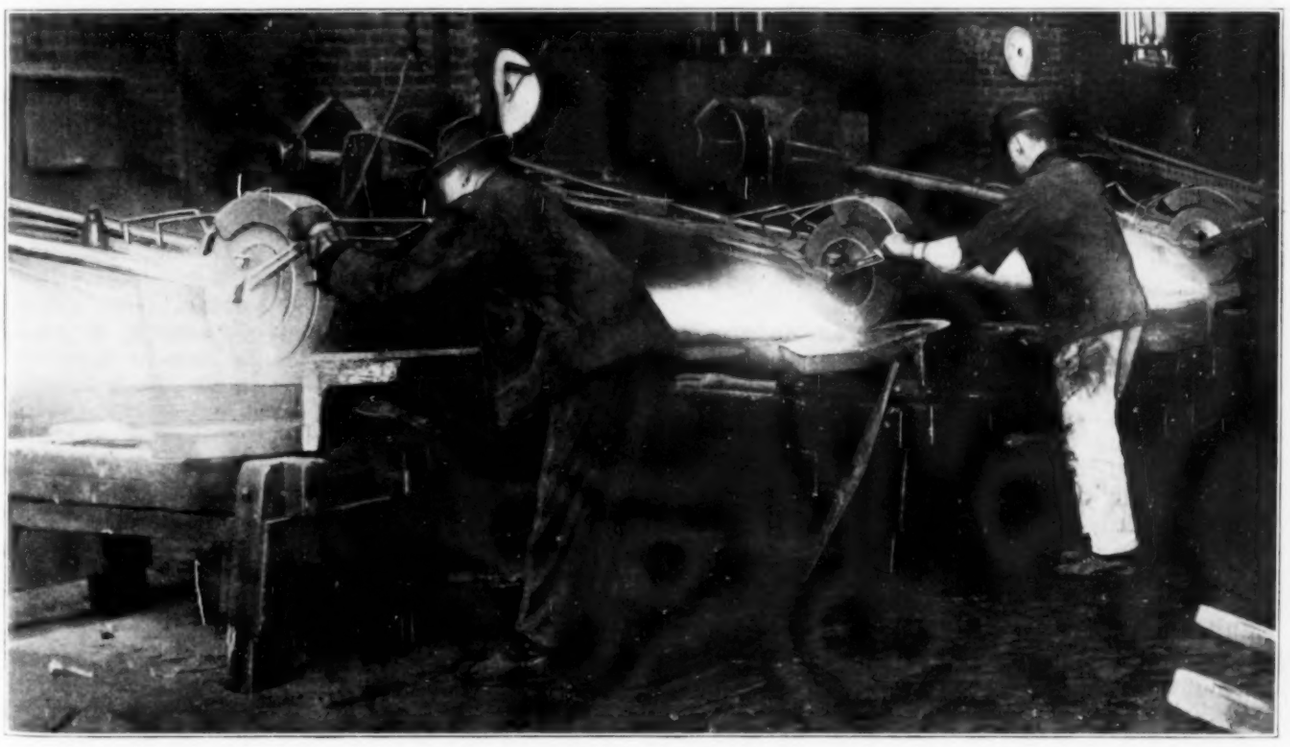


FIG. 1. SNAGGING CASTINGS

In general all holes wanted in the casting must be cored, because it is impossible to drill or bore manganese steel. Where holes must be accurately located provision can be made for drilling them by setting inserts of iron or soft steel in the mold before pouring. Of course, these inserts are necessarily located by coreprints on the pattern and must be larger than the holes wanted, so that any unexpected shrinkage or distortion will still allow the drill to be put through the proper place, leaving enough margin to prevent its touching the casting itself. If, however, the holes are intended to act as bearings for pivots or shafts where the non-wearing qualities of manganese steel are required the object will be defeated as the inserts, after being drilled, will be practically only soft bushings.

As previously stated, manganese steel is exceedingly hard and brittle when cooled slowly, so that before the castings can be put to use they must receive some

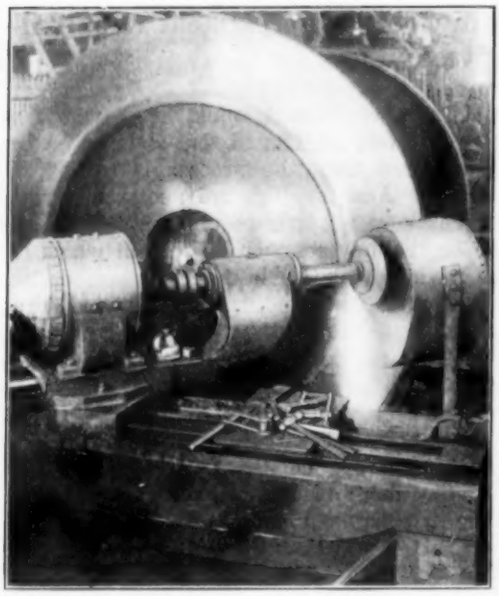


FIG. 2. ANGULAR FACE-GRINDING

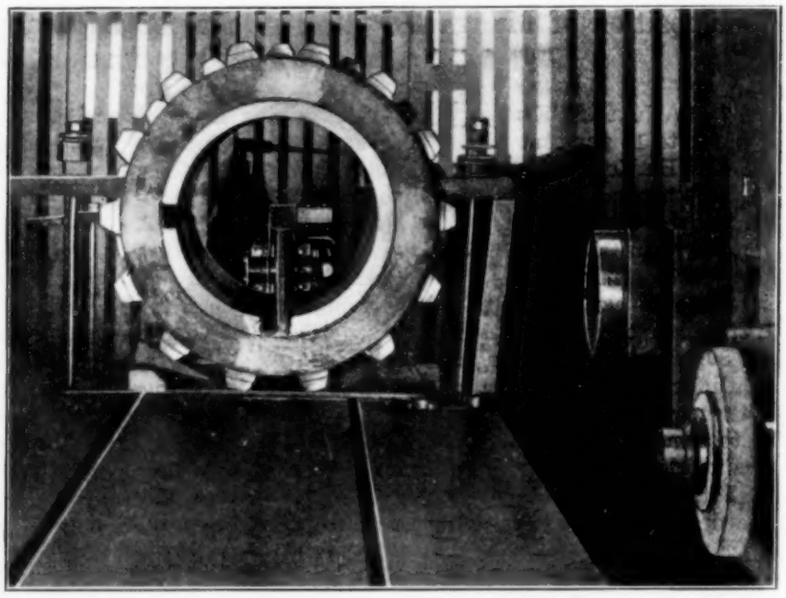


FIG. 3. GRINDING KEYWAYS

treatment for toughening them. This toughening is accomplished by heating them to a white heat, about 1,850 deg. F., and allowing them to soak in the furnace at that temperature from one to two or more days, according to their size. When drawn from the furnace they are quenched in water without previous cooling. This treatment, which would harden steel, results in the castings being tough-hard, in which condition the metal has great resistance to wear due to a peculiar property. The surface will flow under great pressure and in its flow hardens to a great extent and very rapidly, resulting in a hard wearing surface having a ductile backing. A strange thing is that this hard surface is self-renewing, for as soon as a given layer is worn away the next layer, as it becomes surface, at once hardens under the pressure.

Machining Methods

After being heated and quenched the castings are still so hard and tough that they cannot be machined by any of the usual cutting methods, as no tools, either of high-speed steel or stellite, will do the work. The only known method of machining manganese steel is by grinding, and that is both slow and costly—not alone in time but in the terrific consumption of abrasive wheels as well. Hard wheels grind slowly and soft wheels that cut free and fast wear away rapidly, so that the evils to be chosen between are the cost in time versus the cost of the abrasive wheels. This latter is great—greater than would be imagined—for it is the average occurrence for an 18-in. abrasive wheel with 2-in. face to wear away at the rate of one inch of diameter for each hour of use. Then, too, there are other wheel troubles and it seems well-nigh impossible to get two wheels that do not vary from each other in both grade and bond. While this variation might make but a slight difference in general machine-shop use, the punishment the wheels are subjected to in grinding manganese steel makes it very apparent. Sometimes, of two wheels of the same nominal grade and bond, one will wear away twice as fast as the other. Some idea of the abrasive wheel troubles may be had from the fact that one large manufacturer of wheels keeps an expert practically all the time at a certain manganese steel plant for the sole purpose of investigating and reporting the troubles.

The time and expense of grinding manganese steel could no doubt be materially lessened if wheels could be had that did not vary in grade and bond; if the machines were more rigid and some means could be found to better protect the bearings from grit. In connection with the subject of bearings, it appears that ball bearings stand the punishment better than plain bearings.

Snagging the Castings

Snagging is usually done on either portable or swing grinding machines, as castings small enough to be held in the hands while being snagged are rarely made.

Fig. 1 illustrates some of the swing-frame grinding machines in the cleaning room of the Taylor-Wharton Iron & Steel Co.'s plant, High Bridge, N. J., where the data and illustrations used in preparing this article were obtained. The machines shown have an abundance of power and are suspended from one point, allowing universal movement. The volume of the sparks will give some idea of the amount of punishment the wheels are being subjected to. These sparks, as shown in all

the illustrations, were not faked in making either the photographs or the reproductions, but were recorded on the negatives under actual conditions.

In machining operations the wheels are run at a surface speed of from 5,000 to 6,000 ft. per minute, a feed of from ¼ to ½ in. per revolution of the work and a depth of cut from $\frac{1}{64}$ to $\frac{1}{100}$ in., and anyone watching the work being done under these conditions will agree that "This is going some."

Wheels of various grits and grades are used, depending on the class of work being done and on the stiffness of the machine on which they are used. Generally speaking, however, the wheels best suited for grinding manganese steel are from 10 to 24 in grit and from M to T in grade.

Fig. 2 shows a part for a large centrifugal pump being ground. Here, as in most cases, the speed of the work is about 30 ft. per min. It will be seen that the abrasive wheel is being directly driven by a motor mounted on the compound rest of the machine, a flexible coupling being interposed between the motor shaft and the wheel spindle.

Fig. 3 shows finishing one of the two keyways in a shrouded blooming-mill pinion having staggered teeth. The machine in use is of the planer type, though it has no cross-rail. Wheels are mounted on each of the two uprights and are driven by vertical belts from overhead and horizontal belts at or near the wheel level.

In machining the keyways a special attachment is in use consisting of a long tube within which is a shaft driven by a belt from an electric motor. The wheel arbor is mounted horizontally across the end of the tube and power from the shaft to the wheel is transmitted through miter gears. The whole arrangement is pivoted at the rear or driving end and is provided with means for feeding both vertically and horizontally within narrow limits. The function of the machine proper on this job is merely to hold and reciprocate the work, the driving motor and the mounting for the device being located entirely without, and at the rear of, the machine. As the grinding time for each keyway was a little over eight hours, it will be seen that the operation is quite tedious. Incidentally, the hole in this pinion and the small boss surrounding the hole were ground, as were also the shrouds, the latter to the pitch diameter.

The Metric System in Practice

BY JOHN A. GRILL

Just a word about the metric system. We have several machines (Bronger) built in Europe before the war to the metric system. The machines are all right as far as work goes, but the repairing of them is what "gets our goat," for everything is of an odd size—in fact no size to us.

We make the parts all right, but the American way, "the only way," and make every part that goes with it. It is cheaper and quicker in the long run than to get taps, dies, reamers, drills and other things to make a condemned metric part. We have two that are now almost like machines built in America.

It takes too long to bore a hole or chase a thread, other than by our American standard in inches. The metric system is not of any benefit to an American mechanic—in fact to anybody. Everybody should stand shoulder to shoulder and keep the metric system where it belongs. Me for the inches and feet.

English as She Is Understood

BY E. A. DIXIE

It's not so much *what* one says as *where* one says it. A statement may be perfectly correct English, or American, perfectly intelligible in one part of the English-speaking world and still be either quite unintelligible or directly misunderstood in some other locality.

My wife and I recently made a trip across the ocean. On the way over she broke the little spring on one side of her glasses, so as soon as we were comfortably settled at the hotel she and I set out to find an optician who could *fix* them. That's where we made a mistake, we should have done something else, but thereby hangs this tale:

Down near the shipping section we spied a sign which read "Optician and Nautical Instrument Maker," so in we went to have the glasses *fixed*.

The store was in the parlor of a dwelling house and as we entered and closed the door the proprietor came in from the back shop. He was a type of man that it would be difficult to find in the United States. Tall and spare, dressed in somber block of ancient cut, he looked just as though he had stepped from between the covers of one of Dickens' books.

Without loss of time, my wife laid the broken glasses on the counter and said:

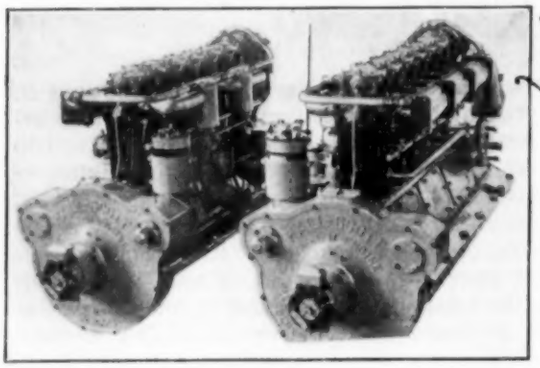
"I have broken my glasses and I would like you to *fix* them."

Old Mortality picked them up, wiggled the little hinge where the broken spring was and solemnly addressed her:

"My dear madam I could not possibly think of *fixing* them, that would be a most unworkman-like thing to do. They are not intended to be *fixed*, that's the reason there is a little hinge on each side of the bridge of the nose. No craftsman who has a reputation to maintain would ever forget himself and his reputation so far as to permit himself to *fix* them. If they were *fixed* they would be rigid, very uncomfortable and unsatisfactory, you remember, no doubt, the old adage about satisfied customers? It is therefore antagonistic to my interests to *fix* them, but I can *repair* them very easily by inserting a new spring. With a new spring correctly set and adjusted they will be quite flexible and as satisfactory as they were when they were new, you remember, no doubt, the old adage about satisfied customers? With a new spring in place they would be perfectly free to adjust themselves to the contour of your nose and would thus be comfortable to wear which they would not be if I were so far to forget my professional reputation as to consent to *fix* them.

"No, madame, I must positively refuse to *fix* your glasses but for the sum of eighteen pence I shall be glad to *repair* them and I can assure you that I shall then number you among the hosts of my satisfied customers, you remember, no doubt, the old adage about satisfied customers? Thank you madame, you can have them by three o'clock, not *fixed* but perfectly *repaired*, comfortable to wear and satisfactory in every way, you remember, no doubt, the old adage about satisfied customers?"

So if any of the readers of the *American Machinist* ever get stranded in England with, for instance, a broken universal joint let them beware of getting it *fixed*.



BUILDING MOTORS ON THE PACIFIC COAST

By Fred H. Colvin
EDITOR-AMERICAN MACHINIST

III. The Principal Operations in Making an Aluminum Alloy Piston—Method of Facing the Inside of the Piston-Pin Boss Differs from Common Practice

THE Hall-Scott motor has an aluminum alloy piston, very similar in design to that used in the Liberty motor. The first operation is to face the skirt and bore the open end, as shown in Fig. 54, on a Jones & Lamson flat turret lathe. The piston is then reversed and held by the open end by an expanding chuck, as shown in Fig. 55. In this operation the piston head is rough turned and faced. Some of the tools are shown in Fig. 56 and the remainder in Fig. 57; a careful study of this tool equipment is worth while.

The piston-pin hole is drilled in the light box-jig shown in Fig. 58, this jig also being used for reaming the hole with the reamer shown. The construction of the fixture is shown more clearly in Fig. 59, where the piston has been removed. This view shows the fork at *A* into which the piston-pin boss fits. This method of locating insures the hole being drilled and reamed in proper relation to the piston-pin bosses.

The method of facing the inside of the piston pin bosses is somewhat unusual and is shown in Figs. 60

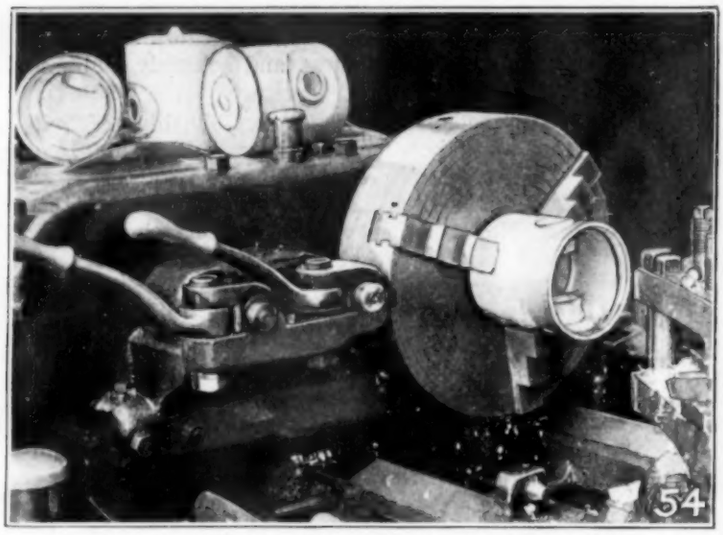


FIG. 54. BORING AND FACING END OF SKIRT

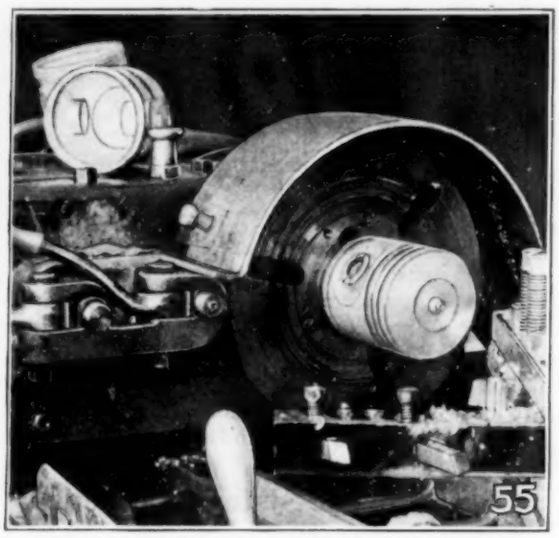


FIG. 55. TURNING AND FACING SOLID END

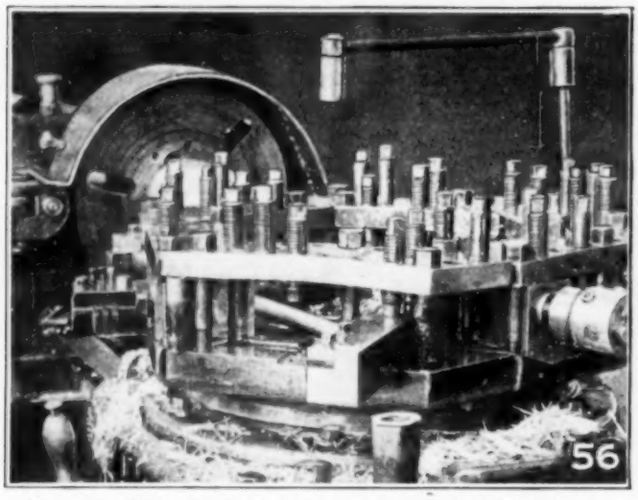


FIG. 56. THE CENTER DRILL AND GROOVING TOOL

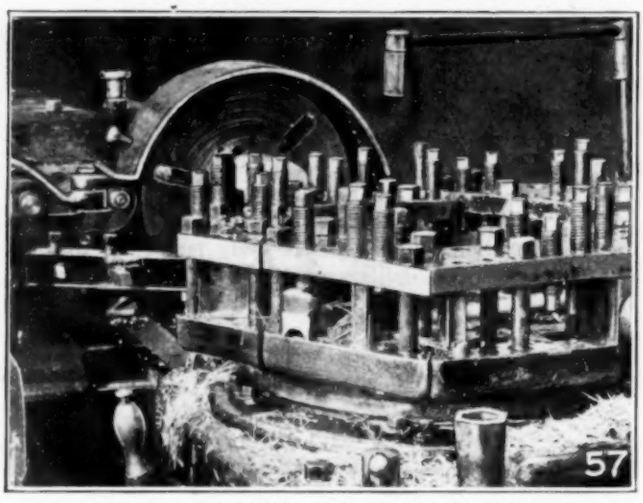


FIG. 57. TURNING AND GROOVING TOOLS

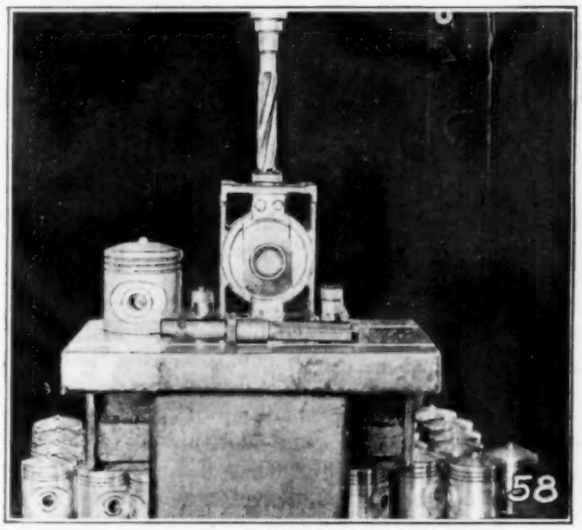


FIG. 58. DRILLING PISTON-PIN HOLE

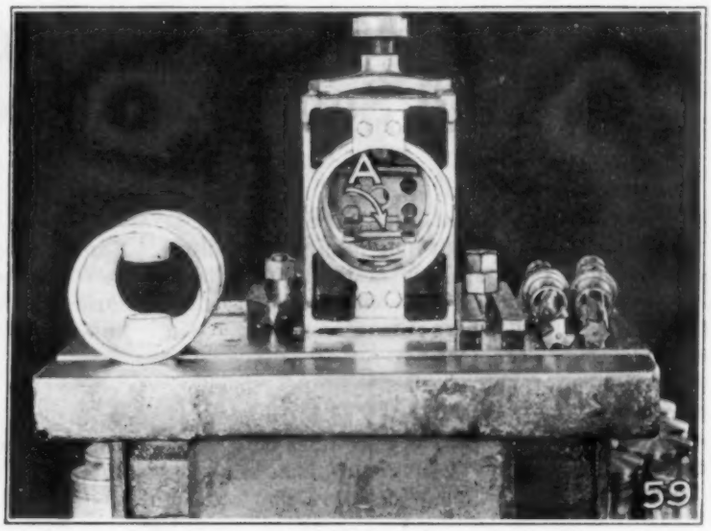


FIG. 59. THE DRILLING FIXTURE

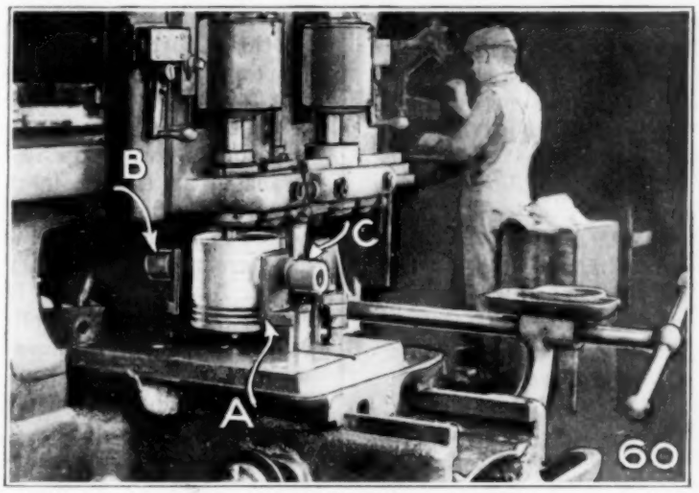


FIG. 60. FACING PISTON BOSSES

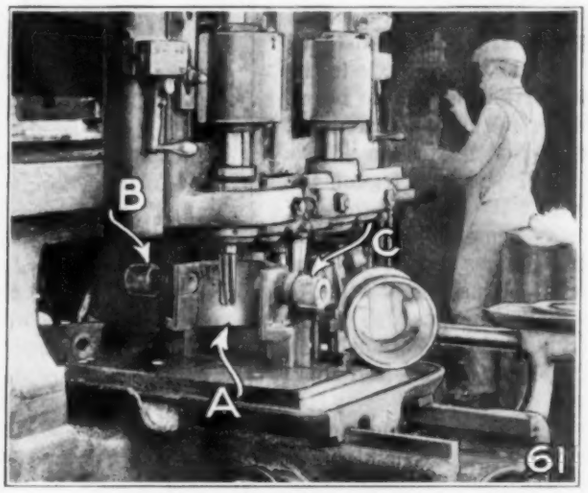


FIG. 61. THE PROFILING FIXTURE

and 61. The piston slips into the fixture *A* and is held by the pins *B* and *C*, which fit into the reamed holes as in Fig. 61. By providing suitable stops it is easy to control the movement of both the table and the milling spindle, making it easy to secure the desired spacing for the upper end of the connecting rod.

Figs. 62 and 63 show the method of slotting the outside end of the piston-pin boss for the piston retainer, which is also similar to Liberty motor practice. The piston fits over the upright *A*, Fig. 63, and is held square by the angle plate *B*. It is then an easy matter to cut the slot at a single passage of the milling cutter.

The final operation is to finish the outside of the piston in the Norton grinding machine shown in Fig. 64, after which it is ready for the assembly department.

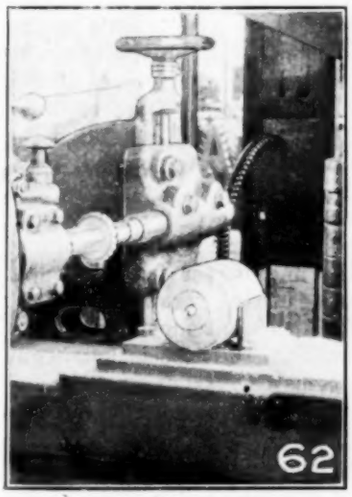


FIG. 62. SLOTTING FOR PIN RETAINER

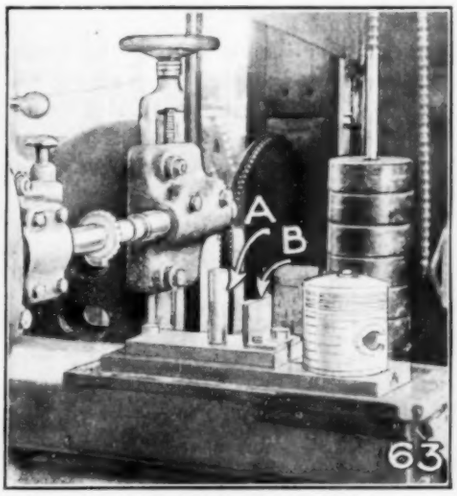


FIG. 63. THE SLOTTING FIXTURE

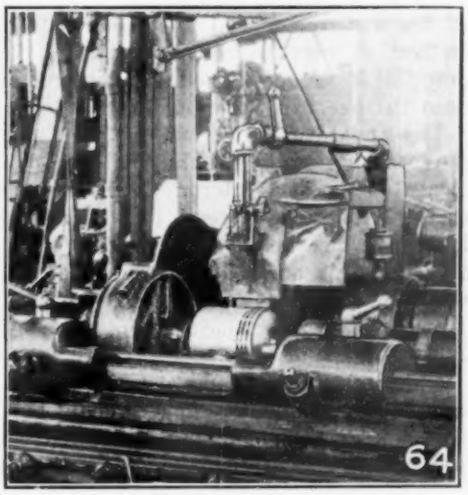


FIG. 64. FINISHING BY GRINDING

An Apparatus for Delicate Flexure Tests and Some Results of Such Tests*

By W. J. FRANCKE

The apparatus described in this paper was designed to test the thin, tempered strip-steel shims used in flexible couplings. These shims are subjected to bending stresses in operation and the apparatus was therefore designed to measure deflection with the idea that the lowest stress at which any change in proportionality of stress to deformation took place could be used as the limiting stress for loading the shims. To accomplish this result, it became necessary to develop and improve the apparatus so that very delicate and accurate measurements could be made. In making tests, one end of the specimen is held in a vise. The weight causing deflection is applied at the other end. Measurements are made with a magnetized micrometer used in conjunction with an electric contact switch. By the aid of this device and an electric light to signal the moment of contact, readings of deflection may be made with great accuracy. Test results, some of which are included, show properties which may be of value since they indicate that further development will make it possible to determine the quality of the constituents of material. Diagrams plotted from many tests show two significant points below the yield point, the lower one of which may indicate the stress at which crystallin slip begins and which may become valuable in fatigue testing. A point is also developed between the yield point and maximum stress which may be of value in judging malleability and ductility.

IN BENDING a cantilever specimen, the stress is localized, and even if not localized definitely to an individual crystal there is thought to be a better chance of determining at what stress slip first occurs than in any test where the stress is uniformly distributed over the entire cross-section of the specimen. The stress is localized at the fulcrum of the cantilever, in tension at the top and in compression at the bottom, the neutral axis of the beam forming the long leg of a lever of which the short leg is the distance from the neutral axis to the top or bottom of the beam. Since the measurements of deflection are taken at the end of the long leg of the lever, it follows that if measurements of 0.00001 in. can be taken at that point, it may be possible to note movements, due to slip in a crystal, so small as 0.000001 in. at the short end of the lever.

The screw micrometer was chosen for making the measurements because it was at the time the only means available. The development of the magnetic micrometer which is used in making these tests in combination with an electric switch which multiplies the distance between the contact points, so that a light can be turned on and off for a movement of only 0.00001 in. has made this method of measurement so delicate, convenient and practical in its application, that other methods have not been further experimented with.

The apparatus is shown in Fig. 1. It consists of the base bar *A* to which the lever *B* is attached by means of the lead fulcrum *C* which permits movement of the lever without resorting to any form of mechanical hinge in which there might be lost motion to interfere with the accuracy of adjustment. The short end of the lever carries a micrometer which is insulated from it. The long end is adjustable by means of the screws *D* and *D'*.

This unit of the apparatus rests in a slot *E* in the upper vise jaw. It is moveable longitudinally in the slot and may be adjusted up and down by means of the screws *F* and *F'*. When the position of this unit of the apparatus is roughly adjusted with relation to the test specimen *G*, it is clamped rigidly in position by two gib screws one of which is shown at *H*.

The other unit of the apparatus is clamped to that end of the test specimen which projects from the vise. It consists essentially of an electric contact switch made up of two members *I* and *J* insulated from each other at *K* and having platinum contact points at *L*. The lower leg *I* is rigid, the upper leg *J* is made of flat strip steel about 0.003 in. thick, formed channel-shaped to make it rigid except for a short distance at the fulcrum end.

Readings are taken by means of an electric light *M* with a condenser *N* connected in the circuit to reduce arcing at the contact points *L*. The battery is shown at *O* and the application of the weight movements to deflect the specimen, at *P*. The micrometer is equipped with a disk *Q* graduated on its circumference to 0.0001 in. Readings to 0.00001 in. may be made by means of a vernier or by interpolation.

The micrometer is a permanent magnet. When it is screwed downward to take a reading, it picks up the upper leg *J* of the contact switch at a point near the fulcrum, thus multiplying the arcing space between the contact points at the other end of the switch. This multiplication may be carried to an extent where the light goes on and off for a movement of 0.00001 in. at the point where readings are taken. Such pressure as is produced in making the electric contact is made uniform by lowering the magnetically-suspended switch to make the contact instead of pushing it down. When making a test, the specimen is clamped in the vise and the electric switch is clamped to the specimen; then the micrometer is adjusted to zero by means of the fine adjusting screws *D* and *D'*, allowing time for any inequalities in temperature of the specimen and vise to equalize. The test is not begun until the zero reading becomes permanent.

The weights causing the deflections are applied in uniform increments. A reading for deflection is taken for each weight increment and recorded, then all weight is removed and a reading recorded for permanent set. This is repeated to the conclusion of the test.

*Paper read at the twenty-third annual meeting of the American Society for Testing Materials.

Specimens should be prepared by grinding so that a practically flat surface is available for clamping in the vise.

The specimens used in the tests described in this paper were filed up by hand. As they are small, usually less than ½ in. square, this is easily done; but the surface clamped in the vise is apt to be slightly rounded so that the danger of indentations by the vise jaw is increased.

Errors are confined to those in the micrometer itself, to temperature errors and to possible spring in the lever due to forcible and improper adjustment. Micrometer errors are reduced by having the micrometer vertical and weighted. When a specimen is clamped in the vise and the micrometer adjusted to zero, the adjustment may not in all cases remain immediately permanent; some minutes may elapse before it becomes permanent; this temporary error may be due to difference in temperature between the specimen and the vise or to slowness of the lead hinge in adapting itself to a change of shape.

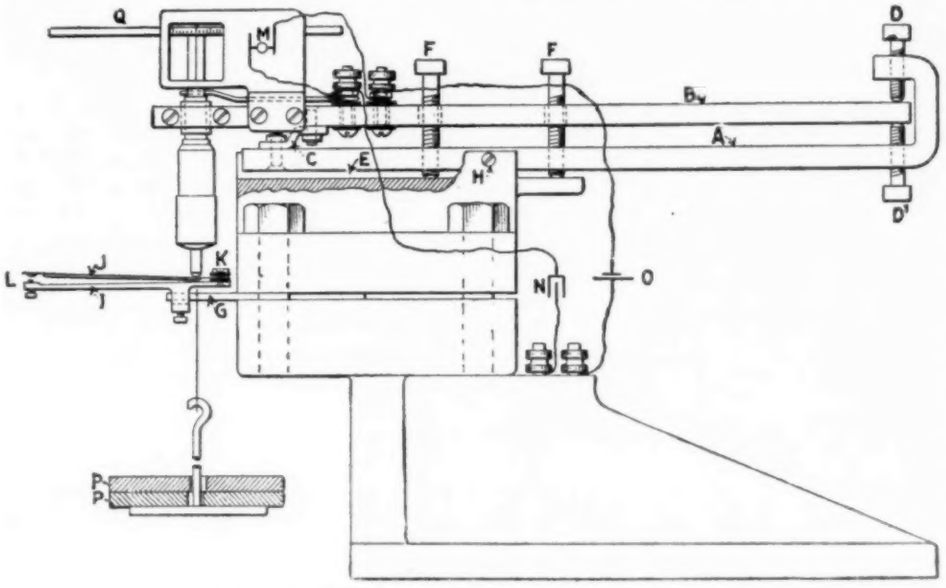


FIG. 1. APPARATUS FOR MEASURING DEFLECTIONS

Another possible source of error is indentation on the lower side of the specimen by the edge of the vise jaw, which would be measured as deflection and therefore cloud the accuracy of results. This matter was called to my attention by Prof. H. F. Moore.

Indentation by the edge of the vise jaw leaves no mark which may be seen with the aid of an ordinary magnifying glass on hard specimens, nor on soft specimens at low stress; on soft specimens at high stress, however, such indentation may be seen without the aid of a magnifying glass in cases where the surface of the specimen is not flat, and indentation shows up on the high spots. It is probable that no indentation takes place in hard specimens and in soft specimens only after permanent bending takes place, and that indentation is negligible in specimens of small section because the total weight employed is too light to cause indentation.

Errors in stress determinations due to using the common formula for flexure beyond the yield point have been neglected.

Differences due to differences in section of the specimen have not been investigated although circular sections, rectangular sections and rectangular sections reduced in area at the fulcrum have been tested.

Nomenclature

It is characteristic of tests made with this apparatus that for nearly all material so far experimented with, six points representing physical changes in the material are developed. The names applied to these points are tentative. In all diagrams they are designated as *F.*, *F. R.*, *Y. Pt.*, *Y. R.*, *P. L.* and *R.* meaning respectively "Fatigue," "Fatigue Range," "Yield Point," "Yield Range," "Plastic Limit," and "Rupture." These terms are defined as follows:

Fatigue is the point where crystals begin to slip or the stress at which failure in the Ferrite constituent is presumed to take place.

Fatigue Range is presumed to indicate the range in which slip in Ferrite continues or the point where failure in Pearlite begins.

Yield Point probably does not record a point where movement first takes place in any crystallin constituent of the material. It is possible that slip in Ferrite crystals has been sporadic up to *F. R.*, taking place in crystals least favorably situated to withstand stress and allowing time for amorphous to harden before other crystals fail. At *F. R.* movement begins to take place in the Pearlite constituent, possibly through slip in Pearlite Ferrite, resulting in increasing deformation of the test specimen as a whole which in turn causes increasingly greater stress to be thrown on the Ferrite crystals which, with diminishing support of the stronger Pearlite, slip in increasing number, slowly at first but in some material soon reaching a point where the slip in many crystals becomes cumulative, time is not allowed for the hardening of the amorphous and a "flow" takes place on many slip planes simultaneously causing the phenomena of the yield point manifested by the drop-of-beam in a tensile testing machine, but not recording a point where failure has first taken place in any crystallin constituent of the material, but recording rather a movement of the amorphous constituent in the slip planes.

Yield Range records the range of this flow, and marks the point where it ceases due to the hardening of amorphous metal in the slip planes permitted by slowing up of the flow due to the gradually decreasing number of large crystals which have now been divided and subdivided by slip, and the exhaustion of the supply of crystals unfavorably situated to resist stress. The material is now presumed to have undergone a complete physical change which began at *F.* with slip in Ferrite Crystals. We are now dealing in a sense with a new material, that is strain hardened steel in which the intergranular amorphous cement has not yet fully hardened and still has some mobility which, however, is probably permitted by a slow movement of the not fully hardened amorphous metal between the subdivided

DATA FOR A SPECIMEN OF MACHINERY STEEL

	Deflection 1	Set 2	Deflection Difference 3	Deflection Difference Minus Basic Deflection = Increase in Deflection per Weight Increment 4	Total Increase in Deflection over the Basic Deflection = Distortion 5	Distortion / Deflection 6	Set / Deflection 7
	0.00058	0.00003	0.00058	0.000073			
	114	10	56	53			
	173	18	59	84		0.00053	
	232	29	59	83		0.00357 =	
	297	39	65	143			
F.....	0.00357	0.00053	0.00060	0.000094	0.000530	0.148	0.148
	429	73	72	213		0.00114	
	499	92	70	193		0.00570 =	
F.R...	0.00570	0.00112	0.00071	0.000204	0.001140	0.200	0.195
	647	138	77	263			
	729	168	82	313		0.003096	
	813	200	84	334		0.010190 =	
	917	241	104	533			
Y.Pt..	0.01019	0.00290	0.00102	0.000513	0.003096	0.303	0.284
	1159	362	140	894			
	1302	439	143	923			
	1505	567	203	1523		0.035583	
	1738	722	233	1814		0.046700 =	
	2120	1029	385	3343			
	2770	1608	650	5993			
	3680	2465	910	8594			
Y.R..	0.04670	0.03353	0.00990	0.009393	0.035583	0.762	0.717
	6050	4691	1380	13293		0.074763	
	7460	5997	1410	13594		0.087400 =	
P.L...	0.08740	0.07285	0.01280	0.012293	0.074763	0.855	0.833
	10600	9060	1860	18093		0.128843	
	12700	11098	2100	20494		0.143000 =	
R.....	0.14300	0.12619	0.01600	0.015493	0.128843	0.900	0.882
	0.16800	0.15043	0.02500	0.024493			

$$\text{Basic Deflection} = \frac{\text{Deflection} - \text{Set}}{\text{No. of Weight Increments}} = \frac{0.00357 - 0.00053}{6} = 0.000506 +$$

crystals as distinct from the earlier "flow" due to slip in crystals.

Plastic Limit marks the end of this movement and is comparable with the maximum strength of the material where necking begins in a tensile test.

Rupture is presumed to be comparable with ultimate strength.

The six points noted are characteristic of hypo-eutectoid steel. It has not been shown that all of them would appear in pure iron where there is only one crystallin constituent, or in a eutectoid steel composed of all Pearlite.

There is also some indication that the Yield Point may be absent in tests of some severely strained material in which the crystals have been greatly subdivided by slip and in which the "flow" which causes yielding has taken place before the test is made, especially if the specimen has been subjected to low heat treatment which seems to check the tendency to yield in strained material.

The Yield Point may also be of indefinite or doubtful appearance in alloy steels if the alloy prevents a "flow" from taking place due to chemical combination of the alloy in Cementite or its solution in Ferrite. In these cases the *Y. R.* point is usually more prominent than the yield point.

The data in the table is for a specimen of machinery steel, the section and length being such that a 1-lb. weight increment produces a stress of 2,500 lb. per square inch in extreme fiber. In column No. 1 is recorded the deflection produced by each weight increment and in column No. 2 the permanent set when all weight is removed.

Columns Nos. 1 and 2 are plotted in Fig. 2 beginning at the lower left-hand corner. The "deflection line" shows the deflection caused by each weight increment and the "set line" the permanent set remaining when all weight is removed. The delicate accuracy of the apparatus is shown by the uniformity of the curve, which is constructed by connecting the plotted points by straight lines.

This curve has little practical value. Close examination, however, will show that it is not a straight line even at the beginning; it curves slightly up to *F.*, is almost straight from *F.* to *F. R.*, curves again from *F. R.* to *Y. Pt.* and curves markedly beyond *Y. Pt.* This slight curvature even at low stress is characteristic of practically all material experimented with and it was a persistent search for the reason of this curvature that resulted in the isolation of the point *F.* by the following method of plotting.

In column No. 3 of the table are entered the differences between each deflection reading and the next following one, showing therefore the deflection caused by each weight increment. It is characteristic of this method of testing to have this column of "differences" show groups of readings, each succeeding group indicating where a change has taken place in the material under test.

The end of the first group, point *F.*, is assumed to be the fatigue point for the reason that as far as records of endurance tests have been available for comparison, the stress at this point coincides approximately with the stress at which slip first takes place.

It will be noted that up to this point *F.*, quite a pronounced and fairly regularly increasing permanent set is recorded. This feature of an increasing permanent set taking place at stresses lower than the stress at which slip in crystals may be expected is also characteristic of all material experimented with although the value of it compared with the deflection varies greatly in different materials. It is assumed that this permanent set below *F.* is caused by some movement other than that due to slip and it is ascribed, in the absence of definite knowledge, to movement in amorphous metal.

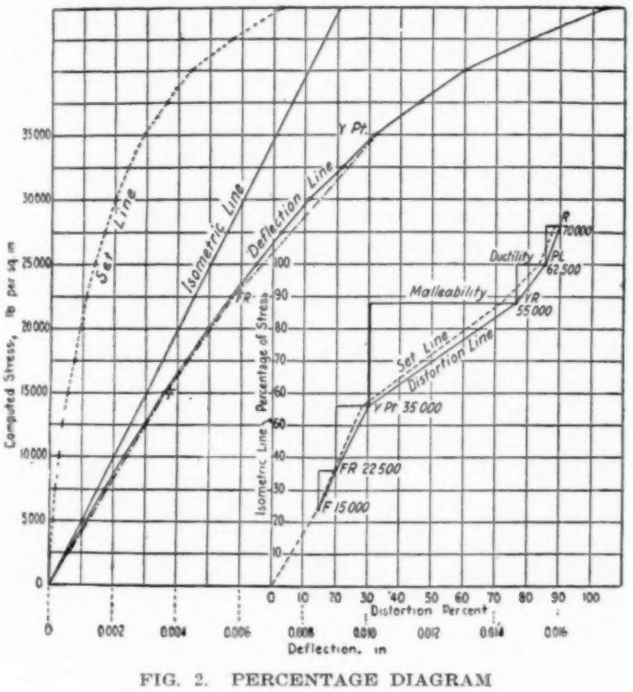


FIG. 2. PERCENTAGE DIAGRAM

With these assumptions, column No. 4 is arrived at by ascribing all movement below *F.* to distortion in amorphous metal and all movement above *F.* to distortion in both amorphous metal and crystallin metal, the word distortion being used to express movement in the constituents of a material as distinct from deformation which is used to express movement in the test specimen as a whole.

If we now deduct the deflection caused by distortion in amorphous metal below *F.* from the total deflection at *F.*, where no crystallin distortion has yet taken place, we may use the remainder, that is the deflection at *F.* minus the set at *F.*, where crystallin distortion is zero, as a basic deflection from which to measure the distortion in constituents above *F.* In this case this basic deflection is: Deflection at *F.*, 0.00357, minus set at *F.*, 0.00053, = 0.00304 and dividing this by the number of weight increments at *F.*, 6, we have the average basic deflection per weight increment, 0.000506+, being the deflection caused by one weight without set and without crystallin distortion, representing therefore theoretically, but only for the purpose of plotting, the deflection of perfectly elastic material at this point.

This basic deflection plotted against uniform weight increments is shown on the diagram as the isometric line.

Column No. 4 shows the remainder, after deducting this basic deflection per weight increment from the "differences" in column No. 3 and therefore the increase in deflection per weight increment, or decrease, in case the basic deflection is greater than the "difference."

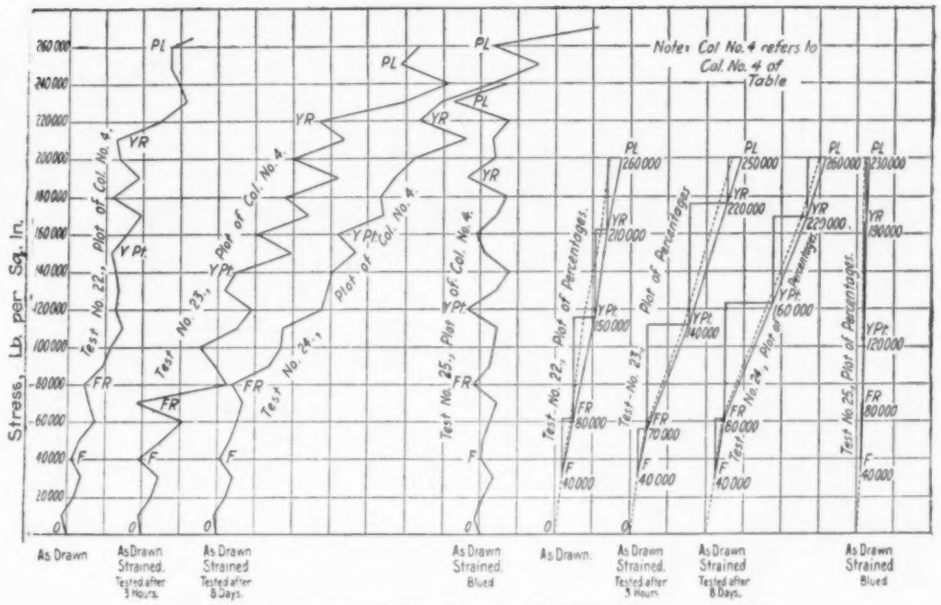

Stress, Lb. per Sq. In.
Note: Col. No. 4 refers to Col. No. 4 of Table
Test No. 22, Plot of Col. No. 4.
Test No. 23, Plot of Col. No. 4.
Test No. 24, Plot of Col. No. 4.
Test No. 25, Plot of Col. No. 4.
Test No. 22, Plot of Percentages.
Test No. 23, Plot of Percentages.
Test No. 24, Plot of Percentages.
Test No. 25, Plot of Percentages.
PL
YR
Y Pt.
FR
F
As Drawn
As Drawn Strained. Tested after 3 Hours.
As Drawn Strained Tested after 8 Days.
As Drawn Strained. Blued

FIG. 4. PATENTED WIRE TESTED IN CIRCULAR SECTION

Column No. 4 is plotted in Fig. 3 in comparison with a stress-deformation diagram which is drawn to no scale and inserted merely to show at what part of the stress-deformation diagram the points *F.*, *F. R.*, *Y. Pt.*, *Y. R.*, *P. L* and *R.* appear.

It will be noted that column No. 4 shows the 6 "groups" more markedly than column No. 3 and that the plotting of column No. 4 brings them out quite clearly. It will be interesting now to look back at the deflection plottings from column No. 1, Fig. 2, and note that the groups are also indicated there, although they are not so clearly defined. The groups often appear so clearly on the data sheets that the plotting of column No. 4 is not necessary in order to locate them.

Diagrams of practical value for comparing different materials cannot be plotted from column No. 4 on account of the long horizontal leg above *Y. Pt.* in ductile material.

In order to get a diagram by means of which materials differing greatly in physical characteristics may be more readily compared with each other, columns Nos. 4 and 2 are plotted on a percentage basis, plotting distortion in percentage of deflection, and set in percentage of deflection. This plotting also makes the distortion graphically comparable with the set. The stress at *P. L.* is taken at 100 per cent. The line of origin for this diagram is the isometric line which is a straight line, being the basic deflection before referred to plotted against uniform weight increments.

Such a diagram is shown in Fig. 2. The distortion line is plotted from column No. 6 showing the total distortion which has taken place

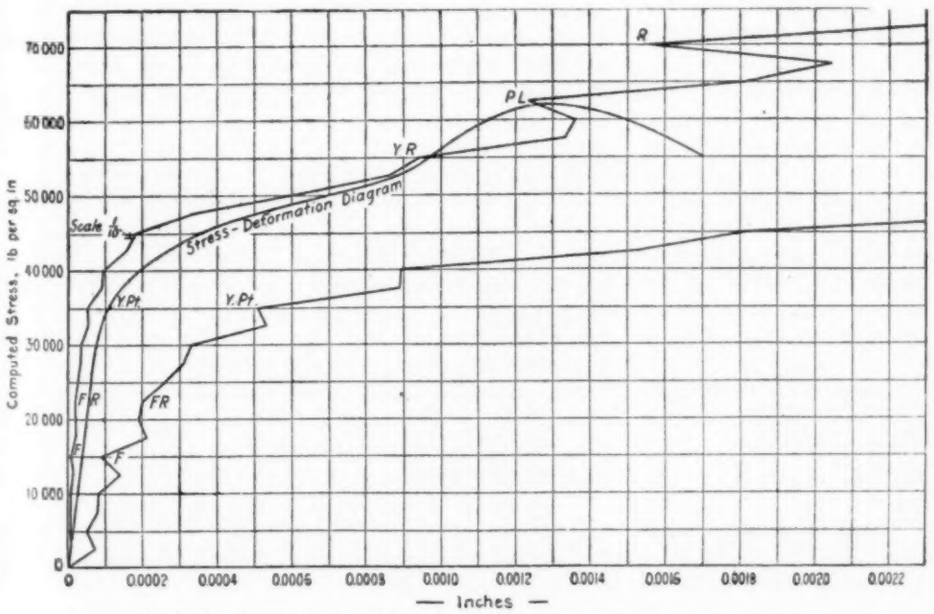


FIG. 3. A COMPARISON OF A PLOT OF COLUMN NO. 4 IN THE TABLE WITH A STRESS-DEFORMATION DIAGRAM

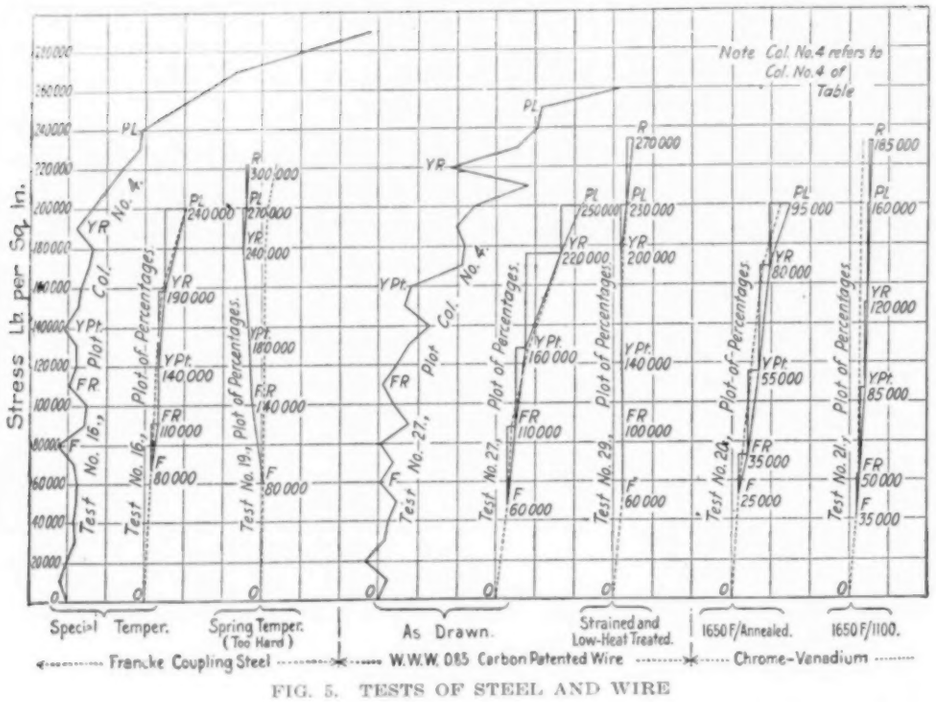


FIG. 5. TESTS OF STEEL AND WIRE

practically a straight vertical line from *F.* up, the set line coinciding with the distortion line.

With annealed material, tests may be made up to *F.* as rapidly as readings can be taken and recorded and usually up to *F. R.*, the light promptly becomes steady showing no further deflection. From the yield point up more time is required.

With heat-treated material, usually the deflection caused by each weight comes promptly to a definite rest where readings may be taken. Strained material generally is slow, and waiting for the specimen to come to complete rest would take a considerable time. In the early part of the test, however, there is little difficulty. Strained sorbite is very slow, some tests having taken 5 hours and then the readings were taken before the specimens came to rest. Such material would probably yield very slowly, perhaps for days, for each weight increment. This slow yielding is completely arrested by heating the specimen to about 500 deg. F. for a minute and the diagram plotted from the low heat-treated specimen takes the shape characteristic of the diagram plotted from a quenched-and-tempered spring specimen.

up to each point in percentage of deflection at that point. The set line is plotted in the same manner from column No. 7. Column No. 5 shows the total distortion up to each point.

Below *F.* this diagram shows the percentage of distortion which has taken place before crystallin distortion began, presumably amorphous distortion.

The little triangles on the distortion line show what has taken place between group points and may reasonably be expected to indicate the quality of that constituent of the material which failed during this period. The horizontal leg shows the distortion which has taken place and the vertical leg the stress that caused it.

The triangle above *Y. Pt.* probably registers the "flow" period of material during which there is great mobility of amorphous as distinct from the plastic period between *Y. R.* and *P. L.* where the amorphous metal has become set but is not fully hardened, the flow period representing malleability and the plastic period ductility.

In a similar manner the triangle between *F.* and *F. R.* may indicate the fatigue quality of a material, for a high fatigue point may not necessarily mean high fatigue quality. A material with a high fatigue point may fail rapidly after slip once begins and a material with a lower fatigue point may conceivably stand more reversals of stress if the injury caused by slip is less due to a difference in the nature of the material. Materials from which a large number of reversals of stress may be expected usually show a small triangle above *F.*

Tests on 0.85 carbon patented wire show that aging strained sorbitic steel for 8 days has little effect except to raise the yield point and maximum while the effect of low heat treatment is very marked as shown in tests Nos. 24 and 25, Fig. 4.

A specimen of patented wire strained and low heat-treated for these tests by E. H. Webb, to whom I am indebted for assistance in preparing specimens, is shown in test No. 29, Fig. 5. In this specimen there is no distortion at all up to *Y. R.*, the diagram being

Employees as Associate Editors of the Plant Paper

BY FRANK H. WILLIAMS

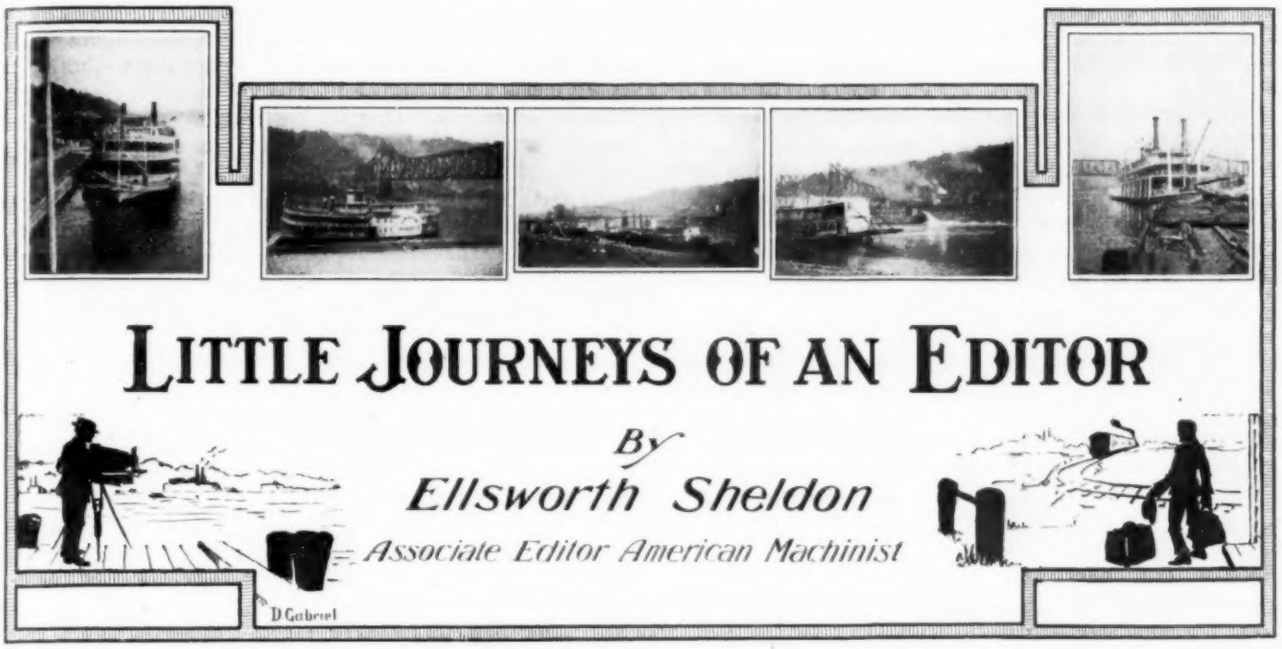
One of the big, outstanding problems faced by every editor of a plant paper is that of getting and holding the interest of the employees in the publication.

Quite often, unless the problem is satisfactorily solved, the employees will hold entirely aloof from the publication and will declare that it is merely another scheme of those "higher up" to try and speed up the workers. But where the interest of the employees is secured and held they quite often feel that the paper is *their* paper and they view it with pride and do everything within their power to help it along.

One of the ways in which the interest of the employees can be secured is by appointing some of them associate editors of the publication. When this is done and when the associate editors are live wires who really do some work and who, by the enthusiasm they put into the proposition arouse the attention of their fellow workers, the paper generally becomes a big success.

Of course the associate editors must be chosen with great care. They must be people who like to see their names and the little items they have written in print and who enjoy the prestige attached to such a position.

Appoint some associate editors for *your* plant paper. It will pay in that it will make the employees feel more as though the paper is *their* paper and less as though it is a form of propaganda coming to them from the executives higher up.



LITTLE JOURNEYS OF AN EDITOR

By
Ellsworth Sheldon
Associate Editor American Machinist

THOUGH the railroads have seriously encroached upon the numbers and prestige of the old river steamboats, Pittsburgh is still an important river port; and although the Rentons have long since ceased to be interested in steamboats, there are other shops to undertake the repairs.

As in the old days, many of the jobs are bigger than the shops that handle them. In such cases the river bank becomes the workshop; the blue sky the roof. Quitting time is when the job is finished and the boat paddles away under her own steam. If the job promises to exceed in point of time the limit of human endurance, the men may work in shifts, going home to sleep; or they may "turn in" in a dry goods box with a coat for a pillow, any time one or more of them can be spared for an hour or two.

Often the roof is not blue, but gray; and inclined to leak. If it leaks too badly sometimes a rude shelter is built of sundry boards and scantlings with tarpaulins thrown over them. If these materials do not happen to be available, why worry? The workmen cannot get any wetter than they already are.

One such job that I saw upon the river bank was the replacing of a defective crankshaft in one of the stern-wheel boats.

The first step is to dismantle the wooden part of the wheel; cutting out the bolts that secure the wooden arms to the iron "flanges" or hubs, upon the shaft and demolishing the "buckets." The boat is then warped up to the river bank, stern first, and a timber crib built up under the shaft.

Lifting the shaft one end at a time by using long timbers for levers, or by means of chain falls suspended from a tripod or a trestle, the crib is built up and the weight gradually transferred until the shaft is clear of its bearings; then the boat is pushed out of the way and the shaft rolled back far enough from the water to enable the workmen to get around it.

Fires of wood are built under the cranks, and a hand pump, set up at the water's edge, is rigged with a hose so that a stream of water may be played upon the shaft to keep it cool or used to extinguish the flames when the crib takes fire. If too much trouble has been experienced in cutting out the bolts from the flanges the wooden arms may be sawed off close to the flanges and, when the shaft has been rolled ashore, fires built around the flanges and the stubs burned out.

The new shaft—a forged billet of steel, hexagon in shape and perhaps 16 in. in diameter across the flats by 20 ft. or more in length, weighing from 7

FIG. 1. LINING THE WHEEL FLANGES ON A NEW SHAFT

FIG. 2. READY TO SHRINK ON THE CRANKS

to 10 tons—has been made ready to receive the cranks and flanges as soon as they are stripped from the old shaft.

Fortunately for the shop that is doing the work (its floor area may not be much over 16 by 18 ft.) the main journals and the shoulders for the cranks have been turned at the mill where the billet was forged. Keyways for the cranks are laid out on opposite ends of the shaft, 90 deg. apart, and cut with chisel and file, the work being done as the shaft lies in its crib on the beach.

To the shop-man who naturally associates keyways with milling machines or planers, such a job with these simple tools would be considered tedious and difficult if not impossible. To these river-men, skilled in the work of making repairs with a minimum of tools and the shop sometimes miles away, it is a simple matter, and when finished is quite as good a job as the average shop-man would produce with all the modern tools at his disposal.

In Fig. 1 is shown such a shaft with the flanges on ready to be lined up. The shaft, as before mentioned, is hexagon; the holes in the hubs of the flanges are also hexagon but are about ¾ in. larger than the shaft. Long slim taper wedges are driven from both sides of each flange between shaft and hub (the draft of the casting both ways from the center providing the mating taper) until the flange is true and in correct position. This is a job that requires time, skill, and experience, for neither the faces of the hexagon shaft nor the hole in the hub are machined, and the flanges are finally supported on all sides by the wedges, the hub not touching the shaft at all.

If the work of driving the wedges has not been conscientiously done the flanges will wring loose in service under the continuous twist and rack to which they are subjected by the engines. If the radial channels that receive the wooden arms are not in line across the breadth of the wheel, one or two flanges will be doing more than their share of the work and will certainly wring loose.

They will probably wring loose anyway if the operating engineer does not keep his eagle eye upon them and "sock up" any recalcitrant wedge that may have started from its position during the last run. To assist him in keeping tabs on them, wedges, shaft, and flanges are kept painted, usually white, so that if a wedge starts from its position the break in the paint renders it conspicuous.

The bar lying across the tops of the flanges in Fig. 1 is a straightedge, of wood, used to locate the keyways at the proper angle and, later, to line up the flanges. Fig. 2 shows the shaft after the flanges have been wedged up and it has been rolled down the bank to the position occupied by the old shaft to have the cranks shrunk on. One of the cranks may be seen in the fire, and the picture also shows the means by which the heavy cranks are handled.

As at this time it was getting toward night I thought in my innocence that I would come down next morning and see that shaft put back in the boat which was then lying at the bank. So at an earlier hour than I usually get out I wended my way to the scene of activities only to find the place deserted. No shaft; no men; no boat. The job had been completed during the night and the boat had sailed away.

The Monongahela River is made navigable for light-draught boats for a distance of nearly 200 miles above Pittsburgh by means of what are called movable dams. At intervals, depending upon the natural fall of the river, are dams, one section of which may be raised or lowered as occasion requires. When the river is in flood these sections are lowered out of the way and boats have a free passage over the whole navigable length of the river, but in seasons of low water the dams are raised to their normal level, impounding water to the depth of nine feet in the "pools," as the intervals between dams are called. Passage of the dams at such times is by means of locks at one side or other of the river.

FIG. 3. LOWER GATE OF A LOCK PARTLY OPEN

FIG. 4. UPPER GATE, CLOSED, AND MECHANISM FOR OPERATING IT

Figs. 3 and 4 are views of one such lock, taken from the deck of a steamer in the act of locking through. Two gates, in this lock 400 ft. apart, are arranged to roll upon a track laid on the sill of the lock, at right angles to the lock-wall. Recesses in the bank are made to receive them so that they may be withdrawn completely from the entrance of the lock basin to allow the passage of a vessel. When a boat is to enter from above, the lower gate is in place, barring the exit from the basin, while the upper gate is drawn back into the bank. The water in the basin is, of course, at the level of the upper pool.

The boat enters the basin and the upper gate is closed. Smaller pneumatically controlled gates located within conduits in the lock walls allow the water in the basin to fall to the level of the lower pool. The lower gate is then withdrawn and the boat is able to proceed on her way.

Fig. 3 is from the forward deck of a down-river bound steamer, and shows the lower gate partly withdrawn; the last stage of the operation. Fig. 4 is from the after deck of the same steamer and shows a part of the upper gate, which is in closed position, while the water is running out of the basin.

The gate is moved back and forth with the double-

FIG. 5. COMING OUT OF A LOCK

cylinder engine to be seen in the center of the picture. A chain, lying loosely upon the gate, is attached to it at either end, there being sufficient slack in the chain to allow for a turn around the barrel of a winch that projects horizontally from the wall of the recess just above the gate. The winch is, of course, driven by gearing from the engine above it, and the opening or closing of a gate is simply a matter of running the engine one way or the other as required until the gate reaches the limit of its movements. The engine, a very ordinary form of steam engine with Stevenson link reversing gear, is operated by compressed air supplied by a constantly running compressor in the lock house.

Fig. 5 was also taken from the after deck of the same steamer, but at another lock, as the presence of the following steamer would indicate. This view gives a general idea of the arrangement of a lock and also shows a portion of the dam to the right.

The peculiar conditions governing Western river navigation have developed peculiar marine construction, both architectural and mechanical, to meet them. Practically the only means of propulsion is the paddle wheel. Screw boats, both tunnel and open screw, have been and are being experimented with but their success is still in question.

Side-wheel boats have, almost without exception, independently driven wheels instead of two wheels on a single shaft with the engine cranks in the center as in Eastern boats. By far the larger proportion of boats in the upper rivers have a single wheel at the stern and two engines, with cranks at 90 deg. upon opposite ends of the same shaft.

Because of the necessarily shallow draft, weight is a vital consideration and the engines are in consequence made as light as possible consistent with strength Pipes, or sometimes bars of wood, are used for rods that no Eastern designer would think of making of any material but steel; chains, or even ropes, are often used for suspension links on the reversing mechanism; connecting rods (called pitmans in Western river parlance) are of wood, and are often double the length of the rest of the engine.

Cast-iron frames or bedplates are unknown. The reason for this is perhaps as much to make the machine flexible as well as to make it light. Sand bars and shallow places abound in the waterways and boats are often aground and the wringing and twisting of the hull in working the boat over or around such places would soon make trouble for both hull and engine if the latter were rigid. The machines are therefore constructed so that they will almost "work around a corner."

A heavy I-beam or a pair of channels is the nearest approach to a bedplate; this important detail is more often composed of a pair of timbers bolted to the deck in an inclined position and extending out over the stern. Cylinders are cast with a foot to be bolted to the timbers; guides are separate pieces independently attached; and the main bearings are bolted to the inner timber and also to extra timbers designed to take the weight and thrust of the wheel.

Valve movements are almost as diversified as the boats themselves. There is a so-called "standard movement" in which there are four lever-operated poppet valves, but almost every boat has its own peculiar modification. The standard construction involves two pairs of wiper tappets not different in principle from the valve mechanism of the old beam engines, familiar to the eyes of Eastern marine engineers. These tappets receive their motion from eccentrics in the usual manner; sometimes through a Stevenson link, but oftener there is no link and to reverse the engine the hook of one eccentric rod must be lifted off the rocker pin and the other hook put on; the idle link meanwhile swinging to and fro in the air, suspended from a piece of line.

With the standard valve movement the speed of the engine, as easily may be seen, is governed by throttling. If there is a Stevenson link the engineer can "hook 'er up," but that only transfers the control from the main throttle to the admission valves.

As most of the engines have a very long stroke in proportion to their cylinder bore, ratios of 6 to 1 and even 8 to 1 being quite common, control by throttling results in great loss of efficiency; therefore most of the modifications have been made with a view to introducing some form of auxiliary cut-off, many of which are ingenious and some of which are efficient. Upon many of the boats, especially upon those whose engines are fitted with piston- or slide-valves, eccentrics are not used. Instead there is a peculiarly shaped cam and yoke that gives an intermittent movement to the valves that lends itself admirably to the auxiliary cut-off principle.

Because of the excessive length of the connecting rod or pitman, which would involve equally long eccentric rods if the eccentrics or cams were placed on the main shaft, these important parts are not infrequently placed on a short shaft located on the inner timber near the end of the guides and turned by an ingenious crank which derives its movement from the pitman.

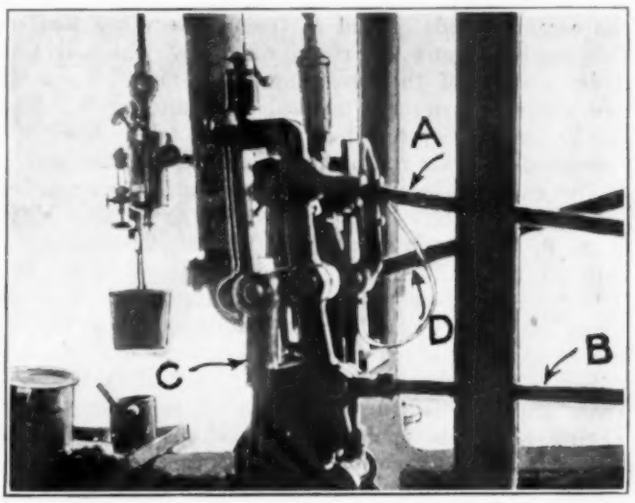


FIG. 6. CORLISS CRAB-CLAW ON A STEAMBOAT ENGINE

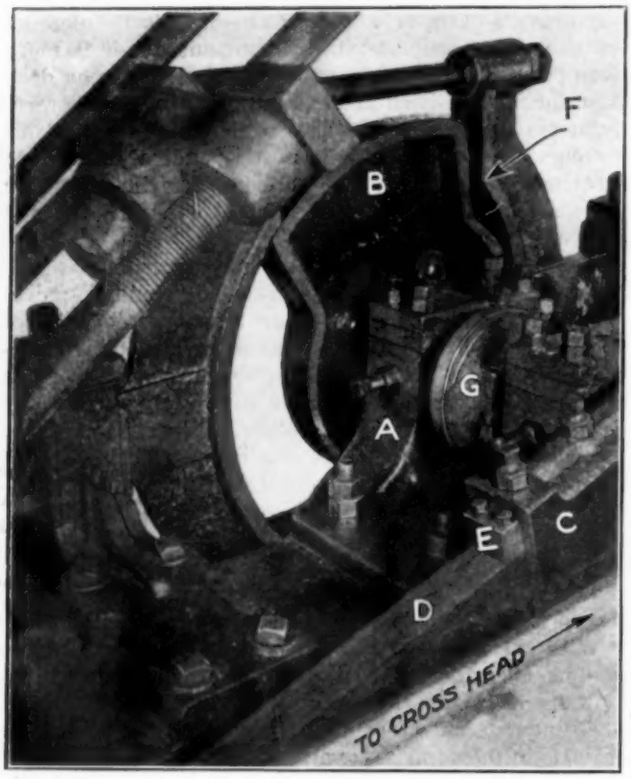


FIG. 7. MAIN CAM AND YOKE WHICH PERFORMS THE FUNCTIONS OF BOTH ECCENTRICS, VIEW FROM OUTBOARD SIDE

On not a few of the boats the cut-off valve takes its movement from a combination of the main valve gear with the movement of the crosshead; and so far as the principle is concerned the resultant is much like that of the well-known Walschaert movement as applied to locomotives.

One engine that I saw which had its valves located about where the throttle ought to be, had four poppet valves, two of which (the admission valves) were lifted by Corliss crab-claws and released by the movement derived from the crosshead. The point of admission and lift of valve were constant but the point of release could be varied at will by the engineer.

This gear is shown in Fig. 6, and though the light conditions were far from favorable for photographic purposes the reader may be able to trace the movement. A Stevenson link attached in the usual manner only to the eccentric rods *A* and *B* (eccentrics were used on this machine) and the reach rod *C* by which it was under control of the reversing lever, moved a rocker arm which in turn lifted the crab-claws alternately. The rod *D* had a reciprocating movement taken from the crosshead and this rod operated the tripping device.

The cam movement heretofore mentioned as being used in place of eccentrics is shown by the pictures, Figs. 7 and 8. These and subsequent pictures show some details of the engines of a large passenger boat—the "Homer Smith"—running out of Pittsburgh. The engines are a pair of tandem compounds with cylinders 16 and 28 in. x 8 ft. stroke.

Fig. 7 was taken from the guard outside the engine room looking toward the center of the room. The engine is at the moment approaching the outboard center in forward motion, and the pitman is therefore rising.

The pedestal *A* is bolted to the inner member of a pair of channel beams that form the bedplate of the engine and its two bearings support the short shaft that has at one end the cam *B* and at the other the rectangular box-shaped part *C*. Through *C* slides the bar *D;* bronze shoes *E*, both on the side shown in the picture and on the other side which is hidden from view, furnishing the bearing surfaces and means to take up wear while allowing the bar to slide freely without shake.

The bar *D* at its outer end (to the left in the picture) is connected by the usual form of crank-connection to a small crankpin which passes horizontally through the wooden pitman (a part of which latter appears in the lower right-hand part of the picture) at a point that just clears the forward end of the guides when the engine is on the back center.[1]

This small crankpin, therefore, travels in an elliptical path, the major axis of which is 8 ft. (equal to the stroke of the engine) and the minor axis about one-third as much (equal to the oscillation of the pitman at this point). The rotary movement of the cam at the point shown in the picture is, therefore, relatively very slow for the reason that the small pin is passing its center with the sliding bar *D* fully extended. When the crank has passed the center and the pitman commences its return stroke the bar *D* slides through the guide *C* until at the moment of passing half stroke the small crankpin is not only very close to *C*, giving a very short leverage, but is moving with the full speed of the main pistons at mid-stroke.

It will be seen from the foregoing that the movement of the cam at the time of contact with the yoke is a very slow one, well suited to the purpose of moving the heavy, and to some extent steam-bound, valves. After the corner of the cam has passed the point *F* on the back part of the yoke, pushing it out of the way and thereby moving the valves, there is no further movement of the latter until the engine reaches the inboard center and the advancing corner of the cam bears against the

[1]To avoid confusion let me explain that the terms "forward" and "back" are relative to the machine; the "forward" end of the engine being the crank end and all parts spoken of as "forward" or "front" therefore being toward the crank. As the boat under discussion is, like most of her contemporaries, a stern-wheeler, these terms are directly opposed to the terms "forward" and "aft," used in a nautical sense.—EDITOR.

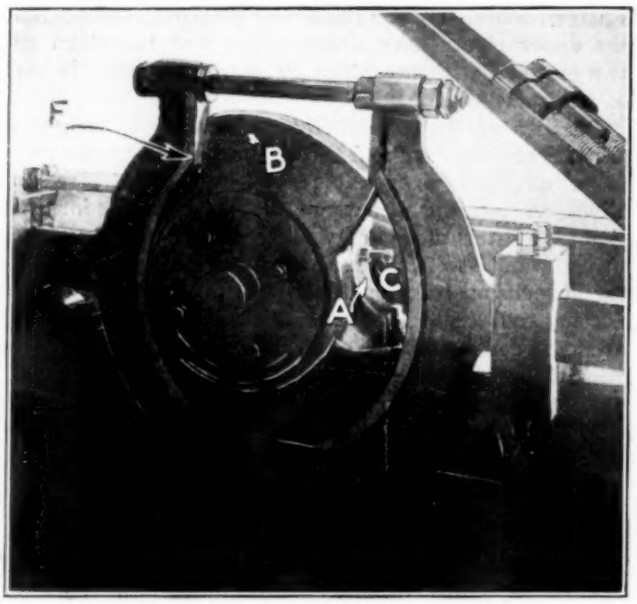


FIG. 8. VIEW OF MAIN CAM AND YOKE FROM INBOARD SIDE

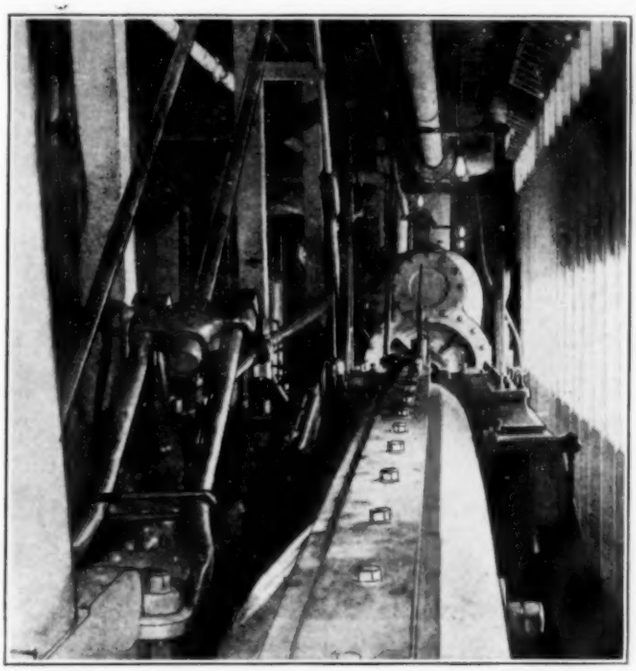


FIG. 9. LOOKING ALONG THE PITMAN TOWARD THE CYLINDERS

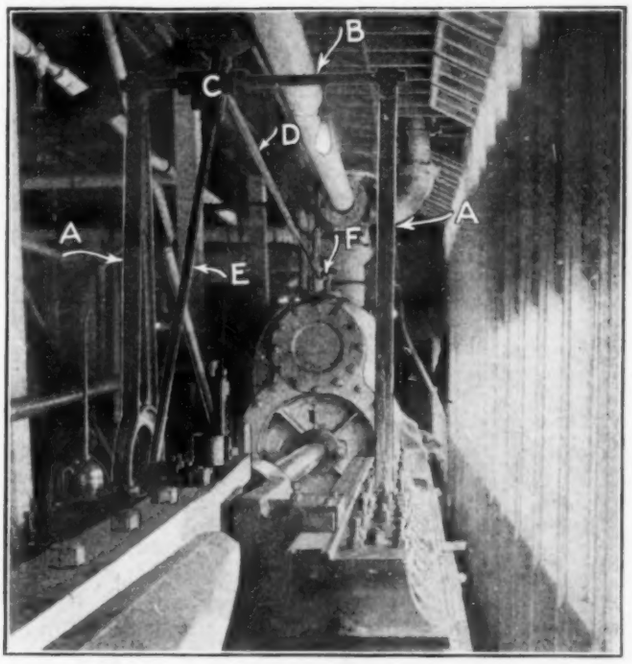


FIG. 10. A NEARER VIEW, SHOWING THE MECHANISM THAT TRIPS THE CUT-OFF

straight portion of the forward half of the yoke corresponding to point *F*, but below the center and on the opposite side of the yoke, ready to move them into position for the outboard stroke.

The movement thus obtained is ideal—for a very slow moving engine. It is quick without being violent; the valves are at rest, wide open, during practically the entire stroke; and the movement takes place at the instant the engine passes the center so that one cam serves to operate the valves for either forward or reverse motion. There is no relative change of position of the parts here shown whether the engine is turning forward or backward; the reversing mechanism does not affect them. Such a movement could not be used to advantage without an auxiliary cut-off, but given that, its only objectionable feature is that it cannot close the exhaust ports quickly enough to give any appreciable compression—not a serious drawback on an engine whose largest piston is 28 in., with a maximum speed of 22 r.p.m.

Fig. 8 shows the cam and yoke from the other side, like letters indicating like parts, giving a better idea of its proportions, and showing how the projecting part of the cam dips in a pan of oil at each revolution. The small eccentric *G*, Fig. 7, was originally intended to operate the cut-off valve, but a change has been made in the movement since putting the boat into commission that transfers that duty to the crosshead as Fig. 9 will show, and the small eccentric is now out of a job.

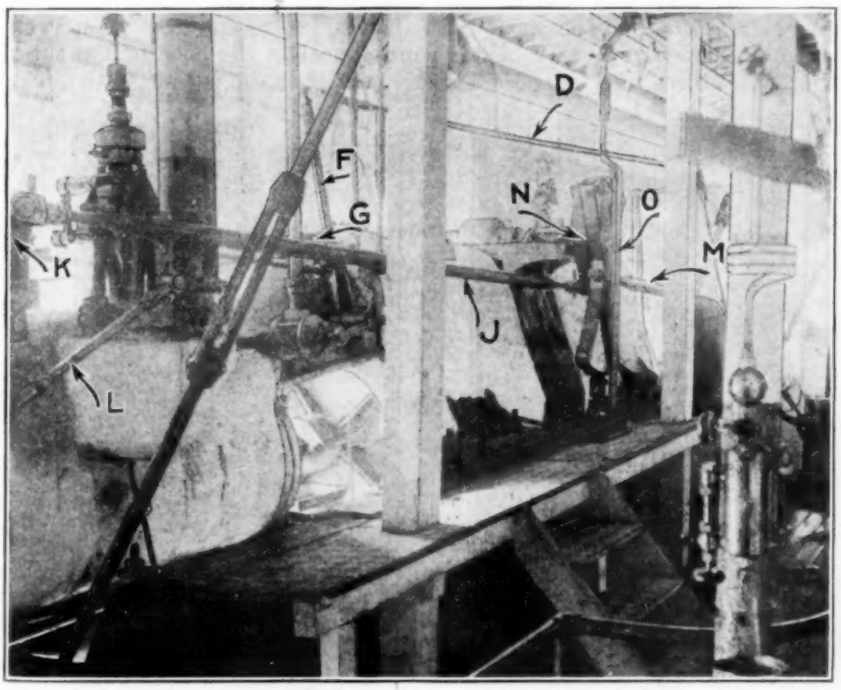


FIG. 11. A GENERAL VIEW OF THE CYLINDERS AND VALVE GEAR OF THE STARBOARD ENGINE, FROM THE OPERATING PLATFORM

Fig. 9 is a view looking into the engine room from the "fantail"—that part of the boat where the wheel is located. The huge timber that apparently fills all the foreground is the "pitman," or connecting rod. It is not as large as it looks, for the foreshortening effect of the lens exaggerates its importance, but even so it is a rather husky stick of timber and several times longer than the rest of the engine. In this picture the details of the cam movement may be traced to better advantage. Figs. 7, 8, 9 and 10 were all made with the engine in the same position.

The picture, Fig. 9, was taken with the camera looking through the opening in the after bulkhead through which the pitman reaches to the crank. Fig. 10 was taken from almost the same point but with a longer focus lens, giving the effect of having been brought nearer to the cylinder. Here

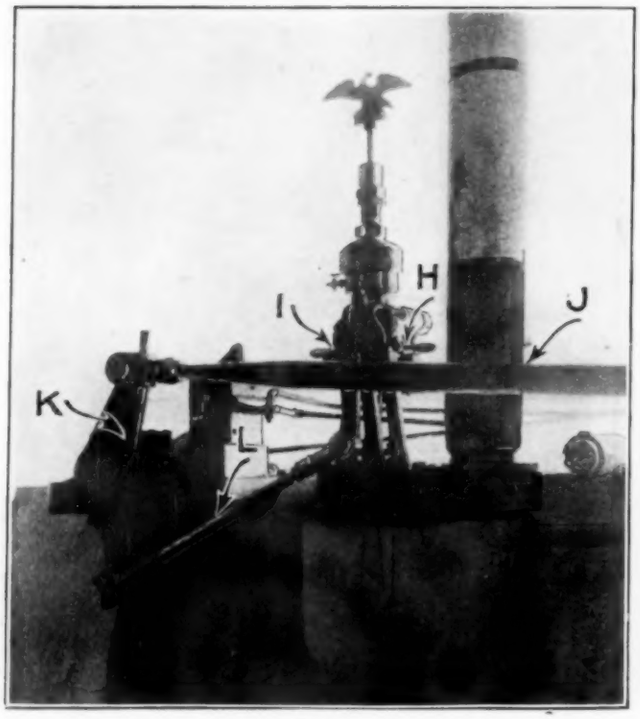


FIG. 12. DETAILS OF HIGH-PRESSURE VALVE GEAR AND CUT-OFF MECHANISM

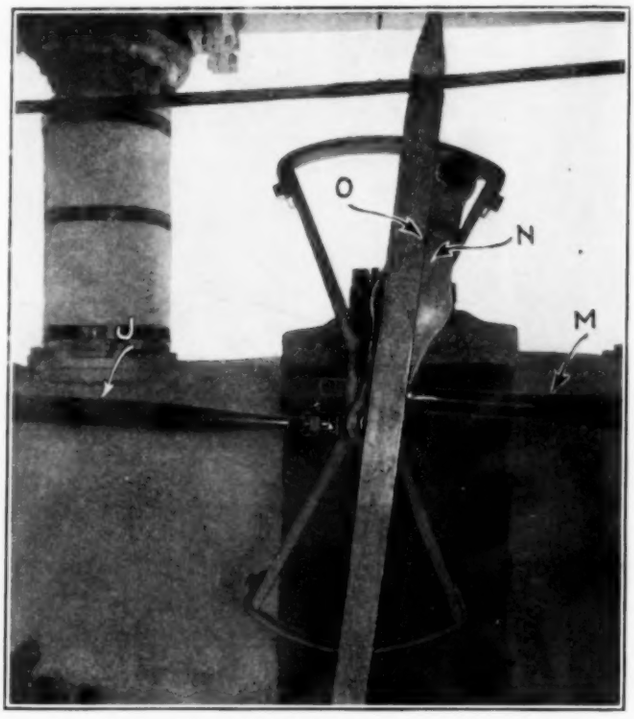


FIG. 13. SIMPLICITY OF THE REVERSING GEAR

may be seen the movement that in conjunction with the main valve movement, operates the cut-off valve. Bolted to the castings that support crosshead guides are two uprights *AA* carrying at their apex the bar *B*. A casting *C* to which is attached the valve-rod *D* swings on the bar, deriving its movement from the crosshead through the rod *E* which is fitted to slide through a bored hole in *C* thus compensating for the varying distance between the bar *B* and the crosshead as the latter moves to and fro.

Rod *D*, Figs. 10 and 11, transmits the motion to the long rock lever *F*, Fig. 11, fulcrumed on the spreaders which separate the high and low pressure cylinders. Upon this rock lever at *G* is a much shorter lever, pivoted at the center, the position of which is always under control of the engineer from the operating platform. From this lever small rods extend to the cut-off release toes, *H* and *I*, Fig. 12, on the valve hood.

The movement is shown more in detail in Fig. 12. *J* is the main valve rod connected to the rocker *K* which moves the high-pressure main valve directly through the stem upon the end of which it (the rocker) is keyed. This valve, as are all the main valves in this engine, is a piston, and is moved by a link and rocker connection to the stem inside the steam-chamber at the center. The excrescence upon the side of the valve-chamber is the body of the cut-off valve.

The short rod *L* moves (every time the main valves move) a double wiper-tappet in the hood of the cut-off valve, and this movement lifts the cut-off valve. Thus

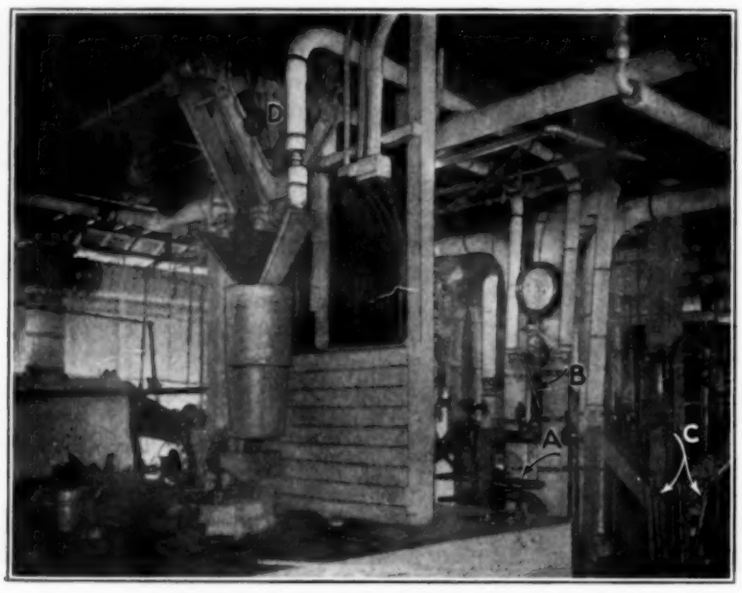


FIG. 14. OPERATING PLATFORM BETWEEN THE ENGINES

FIG. 15. CRANK CONNECTION AND WHEEL

every time the main valve moves in either direction the cut-off valve is opened by one or the other of the release toes and remains open until the moving crosshead, through the somewhat complicated system of levers and rockers, knocks out the release-toe *H* or *I*, depending upon which one happens to be holding up the valve. The bronze eagle shown in Fig. 12 is on the upper end of the valve stem and rises and falls (but does not scream) with every movement.

Reversing Movement Simple

The reversing movement is very simple. The eccentric-rod (or rather cam-rod) *M* is rigidly attached to the large X-shaped yoke which encloses the parts. The link block is also rigidly attached to rod *M*, being a part of the yoke.

I could find no explanation for the above mentioned yoke; it certainly has no function in moving the valves, and if other means of fastening the reach rod from the reversing-engine to the link block had been devised, could as well have been dispensed with.

The lever *N*, seen to better advantage in Fig. 13, is keyed at the center to the low pressure valve stem. It is thus the rocker that moves the low pressure valves, and by reason of the rod *J* being connected by it, it also transmits movement to the high pressure valves. It has still another function; it is made double and the link block slides between its parts so that it is also the reversing link.

O is the reach-rod rigidly attached to the bottom of the X-shaped yoke; so that in reversing, the yoke, the link block, and the eccentric rod *M* all rise together until the block is at the upper end of the link and the link itself oscillates back and forth within the lower part of the yoke instead of the upper part as shown in the picture.

Fig. 14 shows a general view of the operating platform. The throttle is at *A* and the reversing lever at *B*. The two levers shown at *C* are the cut-off controls, and curiously enough are set in opposed positions, so that to shorten the cut-off—to "hook 'er up," as the engineer would say—both levers will be brought toward the center.

The reversing engine is shown at *D*. The lever *B* operates a two-way valve, admitting steam to either end of the reversing engine cylinder and at the same time opens the exhaust ports at the other end. The lever is not connected in any way with the reversing engine, and if the engineer does not use good judgment it is quite possible to slam the piston clean through the head.

Fig. 15 is made from the fan-tail of the boat and shows a part view of the wheel and the crank connections of one engine.

Portable Locomotive-Frame Thermit Welding Outfit

By J. V. Hunter

An excellent portable outfit for conveying the many appurtenances of the thermit welding outfit is found in the Decatur locomotive shops of the Wabash Railway Co.

This outfit is shown in Fig. 1 and shows many of the spare parts carried on it when the welding apparatus proper has been set up for a frame welding job, as shown in Fig. 2.

The wagon is mounted on fairly large wheels so that little difficulty is experienced in running it over uneven flooring. The front axle is pivoted about a king-pin to permit it to be turned in a short radius. The steel

FIG. 1. WAGON FOR CONVEYING THERMIT WELDING OUTFIT

tripod frame on the shelf over the front axle carries the thermit crucible and the latter's cover may be seen resting on it.

The space underneath serves as a place to put miscellaneous tools.

In the center of the wagon is a large locker, the open door of which discloses the stock of plates carried for building molds similar to those shown in Fig. 2. The rear of the wagon is devoted to a couple of bins in

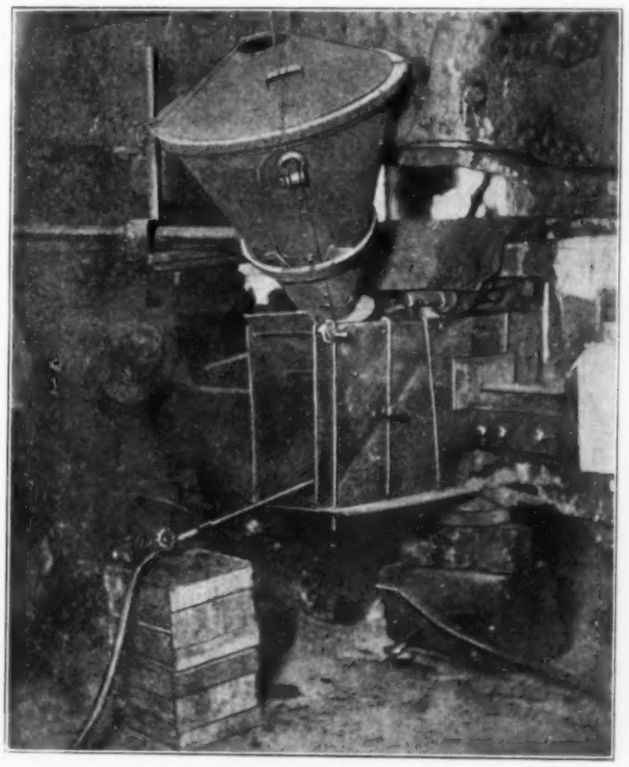


FIG. 2. PART OF WELDING OUTFIT SET UP FOR A FRAME JOB

which are carried the various mold facing and backing-up sands that are required for the construction of a standard thermit mold.

Precise Inspection of Large and Irregular Curves

Only One Long Direct Measurement Required—Heavy Castings Need Not Be Moved About During the Inspection of Curved Surfaces

By ELBERT O. BROWER

WHEN using the method as herein explained for the precise inspection of large and irregular curves, only one of the distances which must be measured directly, is long, while the others ordinarily are comparatively short and easily measured with tools commonly available.

The part to be inspected need not be kept fixed, relative to a surface plate or other reference plane, during the entire time of inspection, and hence it is practicable to interrupt the work of inspection to make additions or corrections and there is no danger that the inspection will be disturbed or time be lost by the accidental changes to which such a fixed set-up is liable.

In the case of a heavy casting which it is difficult to move, it may be practicable to measure its curves without moving the casting at all. In one form of its application the method will indicate clearly the location and amount of any slight lateral bevel in a curved profile and will make it easy to keep a definite record of such inaccuracies.

If a finished templet, perhaps hard all over, is delivered for inspection a couple of buttons may be secured to the templet with C-clamps or other means so that the inspection can be accomplished without any physical change in the templet itself; but it is expedient to put two or more construction holes in the stock and fit pins to them before work on the curves is started. These pins need not be of the same size, but the work is slightly simplified if they are. The holes will facilitate both the machining and the inspection of the curved surface and they will remain available indefinitely for the convenient checking of any part of the profile in the event that a question arises about its condition. In the case of a complex gage such holes may be literally invaluable during construction as means for locating other parts of the device in a desired relation to the curved profile.

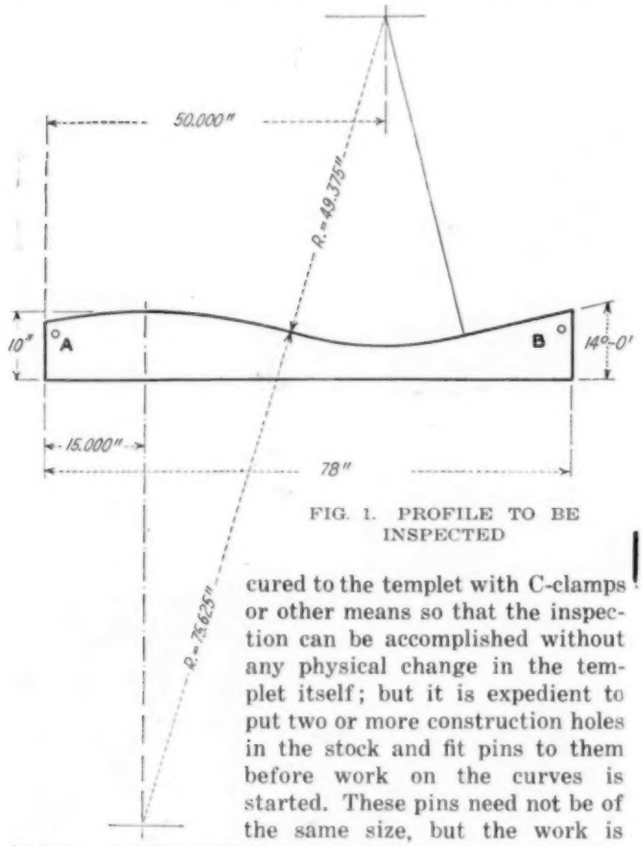


FIG. 1. PROFILE TO BE INSPECTED

To inspect the templet shown in Fig. 1 pins (or buttons) should be located conveniently near the ends as at *A* and *B*. Suppose that both pins have the same diameter of 0.40 in. The distance between the pins, 75.011 in., Fig. 2, should be measured; also the distance 7.3750 in., 6.4694 in. and 1.4482 in. This furnishes data sufficient, when used in conjunction with the dimensions given in Fig. 1, to calculate the distance 73.3570 in. from the center of pin *A* to the point *F* where the center of the convex arc should be and the inclination of this line from the vertical, which is 10 deg. 38 min. 45 sec.

The angle between the center line of the pins and the back of the templet is found by calculation to be 0 deg. 41 min. 30 sec. and the angle *BAF* is found to be 80 deg. 2 min. 45 sec. For the other arc the distance *BG* and the angle *ABG* should be similarly calculated.

The templet should next be placed on edge above a surface plate, Fig. 3, and held at any convenient height and at successively different inclinations in this vertical plane by means of clamps and angle plate. The distance 7.4640 in., 13.7465 in., 12.7150 in. and 19.9340 in. should be measured, finding the crest and trough of each profile with an indicator mounted on a surface gage and transferring these elevations to a height gage, vertical micrometer or size blocks, or using other means for vertical measurement according to the tools available and the degree of precision required. An accidental bevel in the profile will evidently be disclosed by the indicator.

Next subtract 7.4640 in. from 19.9340 in. and divide the remainder by 75.011 in., the center distance between the pins; the quotient is the sine of 9 deg. 34 min. 10 sec., the angle between the pin center line and the surface plate. Subtract this angle from 80 deg. 2 min. 45 sec. (Fig. 2) getting 70 deg. 28 min. 35 sec. which is the angle between line *AF* and the surface plate. Next multiply the distance *AF* which is 73.3570 in. by the

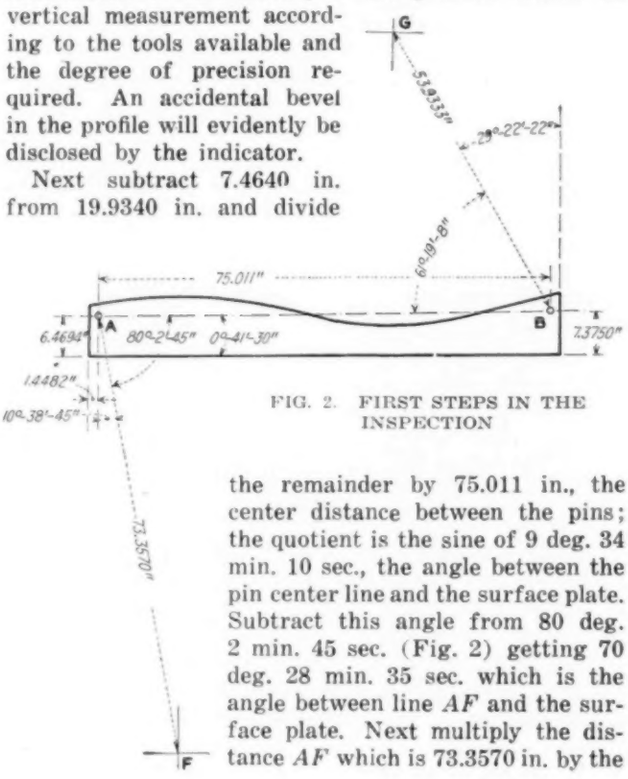


FIG. 2. FIRST STEPS IN THE INSPECTION

TABLE I. ARRANGEMENT OF WORKING DATA

A	B	V	P	D	N	M	L	K	R
7.4640	19.9340	.....	13.7465	(	9° 34′ 10″	70° 28′ 35″	69.1393	75.4218	—0.0032
7.4640	19.9340	.....	12.7150	(	9° 34′ 10″	51° 44′ 58″	42.3544	49.5734	+0.0016
25.4770	8.2165	.....	10.6445	T	13° 18′ 12″	74° 37′ 20″	52.0024	49.5744	+0.0006

sine of 70 deg. 28 min. 35 sec. getting 69.1393 in. and add to this sum the difference between the profile readings at *P* and *A*, Fig. 3, that is, 69.1393 in. + (13.7465 in. — 7.4640 in.) = 75.4218 in. which is less than 75.4250 in. by 0.0032 in. showing that 0.0032 in. too much stock was removed at the point *P*. The value 75.4250 in. is used as the standard for comparison instead of the actual profile radius 75.6250 in. because the indicator touches the upper side of each pin, not the center, it being easier to subtract 0.20 in., the radius of the pin, from 75.6250 in. once and to use this difference for comparison, than to subtract 0.20 in. from each of the different readings taken on the pins.

For the point *Q* of the concave arc the angle 9 deg. 34 min. 10 sec. is subtracted from 61 deg. 19 min. 8 sec., leaving 51 deg. 44 min. 58 sec., and the sine of this angle is multiplied by 53.9333 in. To this product, 42.3544 in., is added the difference between the readings at *B* and *Q*, Fig. 3, that is, 42.3544 in. + (19.9340 in. — 12.7150 in.) = 49.5734 in., which is less than 49.5750 in. by 0.0016 in., showing that 0.0016 in. more stock should have been removed at the point *Q*. The value 49.5750 in. is found by adding the pin radius to the radius of the profile arc in order to avoid as before the changing of the pin readings.

The templet should now be shifted on the angle plate to a new inclination and the preceding operations repeated.

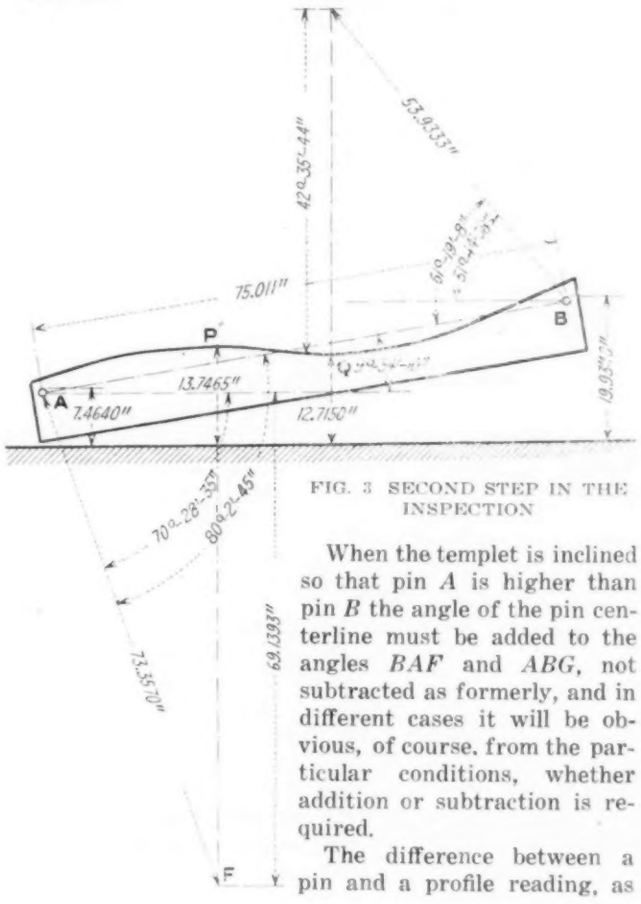


FIG. 3 SECOND STEP IN THE INSPECTION

When the templet is inclined so that pin *A* is higher than pin *B* the angle of the pin centerline must be added to the angles *BAF* and *ABG*, not subtracted as formerly, and in different cases it will be obvious, of course, from the particular conditions, whether addition or subtraction is required.

The difference between a pin and a profile reading, as the difference between 19.9340 in. and 12.7150 in., is sometimes to be added and sometimes to be subtracted from the corresponding product, such as 42.3544 in. in this instance; to be certain which operation is required in any doubtful case both may be performed and of these two results the one which is nearer to the corrected profile radius should be used to get the value of the surplusage.

To determine the position of a straight section of a profile the templet should be shifted on the angle plate until an indicator shows that this straight section is parallel to the surface plate. Then readings on the pins will show the angle of the flat relative to the pin centerline and a reading on the flat will determine the perpendicular distance to the flat from either of the pins.

If the flat is tangent to an arc of the profile the difference between the pin and profile readings follows the same routine of calculation as if the profile reading had been on the arc instead of on its tangent, the resulting surplusage being that of the flat at its point of tangency to the arc. The error, if any, in the angular direction of the flat, when considered with the surplusage at the point of tangency, will show the surplusage at any other point of the flat. Thus, in Fig. 4, if the reading on the tangent, when it is parallel to the surface plate, is 10.6445 in. and the readings on *A* and *B* are 25.4770 in. and 8.2165 in. respectively, $\frac{25.4770 - 8.2165}{75.011}$ equals the sine of 13 deg. 18 min. 12 sec., which angle added to 61 deg. 10 min. 8 sec. (Fig. 2) equals 74 deg. 37 min. 20 sec.; the sine of this angle multiplied by 53.9333 in. equals 52.0024 in., which is greater than 49.5750 in. Therefore, 2.4280 in., the difference between profile reading 10.6445 in. and pin reading 8.2165 in., is subtracted from 52.0024 in., leaving 49.5744 in. which is 0.0006 in. less than the corrected profile radius, showing that 0.0006 in. more stock should have been removed from the flat at the point of tangency. The angle 13 deg. 18 min. 12 sec. added to the angle 0 deg. 41 min. 30 sec. (Fig. 2) equals 13 deg. 59 min. 42 sec., showing that the flat has an angular error of 18 sec. (specification, Fig. 1, calls for 14 deg.) and that the direction of this error is such as to diminish the surplusage of the flat when moving away from the point of tangency. Taking the cotangent of 18 sec. as 11,460 and multiplying it by 0.0006 in., the surplusage at the point of tangency, the product, 6¾ in., is the distance from the theoretical point of tangency to that point of the flat where the surplusage is zero and beyond this point the surplusage is evidently negative.

While taking measurements at the bench it will be expedient to record the readings in some uniform style allowing space on the original sheet for the addition of some of the calculated values. These notes can be arranged as shown in Table I.

In columns A and B are recorded the readings from the tops of the pins to the surface plate. In the next column is space for notes on accidental bevel in the profile surface. In column P are recorded the profile read-

ings. In column D (designation) may be recorded characters to indicate whether the reading in column P was taken at a trough or crest, a tangent or some special element of the device. Column N contains the angles of the pin centerline with the surface plate. In column M are the sum or difference angles showing the several inclinations of the lines *AF* and *BG*. Under *L* are noted the several products obtained by multiplying the sines of the angles or column M by the distances *AF* or *BG* and under *K* are listed the final sums

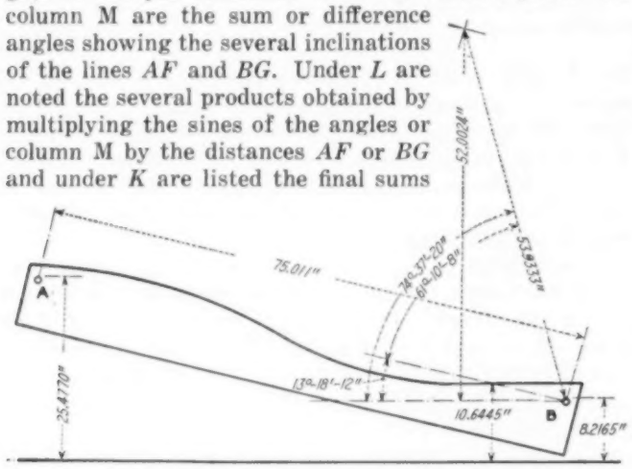


FIG. 4. ARRANGEMENT FOR INSPECTION OF A STRAIGHT SECTION OF A PROFILE

and differences which are to be compared with the corrected profile radii, to get the values of the errors which are recorded in column R.

In a case where the construction pins are of different diameters a convenient way to make allowance for the disparity is to add to each reading on the smaller of the pins a correction equal to the difference in the radii of the pins, the later calculations being made the same as if both pins were actually the diameter of the larger. According to the personality of the workman concerned with the job it may or may not be advisable in such a case to add a column to Table I, so that there will be recorded and preserved both the original and the corrected readings on the smaller pin. Of course all the readings on both pins could be reduced at once to values corresponding to the centers of the pins if such a procedure were preferred by the inspector.

The angles in column L can be conveniently used for laying out the locations of the several readings on a scale drawing, as shown by Fig. 5. With the surplusage values marked on such a drawing the results of the inspection may be seen at a glance.

If a circular arc is delivered for inspection with no mention of the supposed numerical value of the curvature its radius can be calculated and the position of its center determined after three readings have been taken on the curve; and if the arc is only approximately circular, such radius and center may be accepted tentatively while further readings show how closely the entire curve agrees with a true circular arc passing through the three points first measured.

If a templet has no finished edges except a profile surface which is entirely curved, the specification requiring nothing more than that the curves of the profile be in proper relations to each other, the actual or intended position of each center may be quite unknown. If the values of the different radii are known or assumed in such a case two readings on any arc will be sufficient to locate its center relative to the buttons or measuring pins; the several locations thus found after being compared with the profile specifications and possibly adjusted, can be tentatively used as a basis for a thorough inspection of the profile. If one of the radii is unknown three readings on that arc will be required.

After a position for the center of an arc has been accepted tentatively, if later readings show that a different point must be used, the readings which have been taken on the arc, that is, the pin and profile elevations already actually measured, are not lost, of course; only the calculations made from the unsatisfactory center must be discarded. Thus, suppose that a certain arc of a device is required to be of a given radius and in a certain position while actually the curvature and the location of the center are both in error. One complete series of pin and profile elevations can be used to prepare three inspection reports: First, taking the center of the arc in the desired location the resulting surplusage values indicate the discrepancies between the actual curve and the print specifications; second, with the center at a point determined by calculation the surplusage values tell how much the curve deviates from the nearest true circular arc with which it can be compared, the size and position of this perfect arc being definitely known, of course; third, selecting for the center of the arc a new arbitrary point to which other parts of the device can be made to agree by possible alterations, the surplusage values show where and to what extent stock must be removed from the profile in order to salvage the device.

Suppose that readings have been taken at three points, P_1, P_2 and P_3 on an arc of unknown radius R. Let p_1 represent the reading at P_1, that is, the distance of P_1 from the reference plane and let a_1 and b_1 represent the distances from the reference plane to the CENTERS of the measuring pins A and B respectively. Similarly let p_2, a_2 and b_2 represent the profile and pin readings for the second point P_2 of the arc, etc. In order to condense the formula let $N_1 = \sin^{-1} \frac{(a_1 - b_1)}{AB}$; and similarly let $\sin N_3 = \frac{(a_2 - b_2)}{AB}$, having regard for all the signs. Also let $N_{12} = N_1 - N_2$ and let $N_{23} = N_2 - N_3$, regarding the signs of N_1, N_2 and N_3 but calling N_{12} and N_{23} positive in all cases. Then $R =$

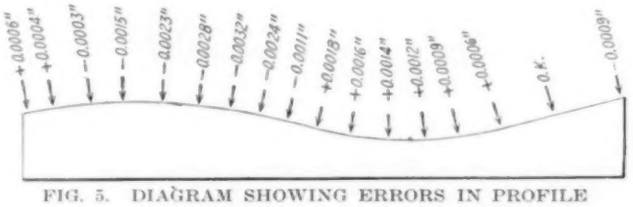


FIG. 5. DIAGRAM SHOWING ERRORS IN PROFILE

$$\frac{(p_1 - a_1)\ \text{cosec}\ N_{12} + (p_2 - a_2)\ \text{cosec}\ N_{23}}{\tan \tfrac{1}{2} N_{12} + \tan \tfrac{1}{2} N_{23}} - \frac{(p_2 - a_2)\ (\cot N_{12} + \cot N_{23})}{\tan \tfrac{1}{2} N_{12} + \tan \tfrac{1}{2} N_{23}}$$

Referring to Fig. 6 it will be seen that

$$(p_1 - a_1)\text{cosec}\ N_{12} = UW$$
$$(p_2 - a_2)\text{cosec}\ N_{23} = AZ$$
$$(p_2 - a_2)\ (\cot N_{12} + \cot N_{23}) = HW + YZ$$

and

$$AZ + UW - HW - YZ = UV$$
$$= R(\tan P_2FU + \tan P_2FV),$$

which shows the derivation of the formula. Regardless of the positions of the pins A and B the formula will hold true if the signs of the several terms are properly regarded, a negative value of R resulting when

the concavity of the arc is directed away from the reference plane.

As the orientation of any actual arc will be already otherwise manifested the sign of R is immaterial, hence the formula may be written also as follows:

$$R = \frac{(a_1 - p_1)\ \text{cosec}\ N_{12} + (a_3 - p_3)\ \text{cosec}\ N_{23}}{\tan \tfrac{1}{2} N_{12} + \tan \tfrac{1}{2} N_{23}} - \frac{(a_2 - p_2)\ (\cot N_{12} + \cot N_{23})}{\tan \tfrac{1}{2} N_{12} + \tan \tfrac{1}{2} N_{23}}$$

and either expression may be used in any particular case though the one may be preferred which would

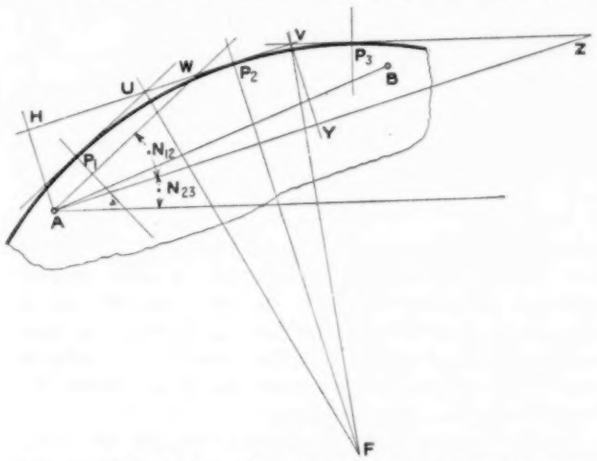


FIG. 6. DIAGRAM FOR DERIVATION OF FORMULA FOR RADIUS

make a majority of the pin and profile differences positive.

After thus finding the radius of an arc, in order to determine the position of its center F relative to the pins A and B, find the angle M_2, Fig. 7, such that $\cot M_2 = \dfrac{(R + a_1 - p_1)\ \text{cosec}\ N_{12}}{R + a_2 - p_2} - \cot N_{12}$. Then the angle $BAF = M_2 - N_2$, regarding all the signs, the angle BAF being greater than 90 deg., of course, when its cotangent is negative, and the distance $AF = (R + a_2 - p_2)\text{cosec}\, M_2$. The center of the arc is now located in the manner which is requisite in order to proceed with further inspection of the arc by the tangent method.

For a derivation of the formulas, it is seen that M_2 is the angle EAF and that it corresponds to the angle which would be recorded in column M of Table I, in line with the readings for the profile point P_2 if the center location were already known and that N_2 is the angle EAB.

$$\cot EAF = \frac{AS}{FS} = \frac{AE - SE}{FS} = \frac{AT\ \text{cosec}\ N_{12} - FS \cot N_{12}}{FS} = \frac{AT\ \text{cosec}\ N_{12}}{FS} - \cot N_{12}$$

and as $AT = R + a_1 - p_1$
and $FS = R + a_2 - p_2$

the relation $\cot M_2 = \dfrac{(R + a_1 - p_1)\ \text{cosec}\ N_{12}}{R + a_2 - p_2} - \cot N_{12}$ is shown.

By transposing the above slightly we get:

$$\cot M_2 = \frac{R + a_1 - p_1 - (R + a_2 - p_2) \cos N_{12}}{(R + a_2 - p_2) \sin N_{12}}$$

which may be preferable sometimes because the involved quantities are smaller numerically.

In these formulas for finding the radius of an arc and locating its center it has been assumed that all the pin readings have been corrected to correspond with imaginary readings at the centers of the pins. With pins of the same radius, as 0.2000 in., instead of subtracting this amount from each pin reading, if this same 0.2000 in. were added to each profile reading, it will be seen that the correct value of R would result from the formula whether the pin radius correction were applied to the pin readings or to the profile readings. But suppose that neither the pin nor the profile readings are corrected for the amount of the pin radius. It will be evident that the evaluation of the formula will give a radius which is 0.2000 in. greater than the actual radius, and that in any case the difference between the calculated radius and the actual one will always be equal to the pin radius exactly, though the direction of the difference will depend jointly upon whether the arc is measured with its convexity toward or away from the reference plane and whether the pin readings are taken on the sides of the pins which are nearest to or farthest from the reference plane. Without troubling to be certain whether the actual radius is greater or less than the calculated one this value may be used in the second formula with the uncorrected profile and pin readings to find the location of the common center of both arcs and after the center is located in this manner the direction of the error will be unmistakable.

If a case requires nothing more than to determine the radius of a single arc which is assumed to be truly circular it may sometimes be accomplished conveniently

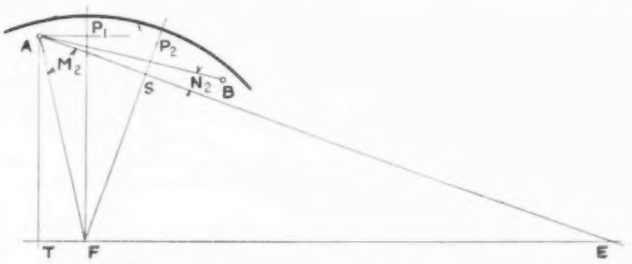


FIG. 7. TO DETERMINE POSITION OF THE CENTER AFTER HAVING FOUND THE RADIUS

by placing two buttons of equal size in contact with the arc and measuring the distance between the buttons and the lateral location of the crest of the curve. A certain common type of sine bar could be handily used for an arc of corresponding length, the center distance of its pins being already known.

Referring to Fig. 8, the distance H between the trough of the concave arc and the straight edge T is measured with a plug gage L and the size blocks J or in some other satisfactory manner and the distance K between the buttons is measured by some method dependent upon the tools available. With the diameter of each button denoted by d and the required radius by R,

$$R = \tfrac{1}{2}\left[\frac{(K + d)^2}{4\ (H - d)} + H\right].$$

The derivation of this formula is as follows:

In the similar triangles ACB and BCD

$$AC : BC = BC : CD$$

or $$AC = \frac{\overline{BC}^2}{CD}.$$

Now $DE = \frac{1}{2}d$, $CG = \frac{1}{2}d$

and $CD = GE - ED - CG.$

Therefore $CD = H - d.$

Also $BC = \frac{1}{2}(K + d).$

Therefore $$AC = \frac{\frac{1}{4}(K+d)^2}{H-d} = \frac{(K+d)^2}{4(H-d)}.$$

Now $AF = \frac{1}{2}d = CG.$

Therefore $AC = FG.$

Also $R = \frac{1}{2}(FG + GE),$

that is, $R = \frac{1}{2}(AC + H)$

and finally $$R = \frac{1}{2}\left[\frac{(K+d)^2}{4(H-d)} + H\right].$$

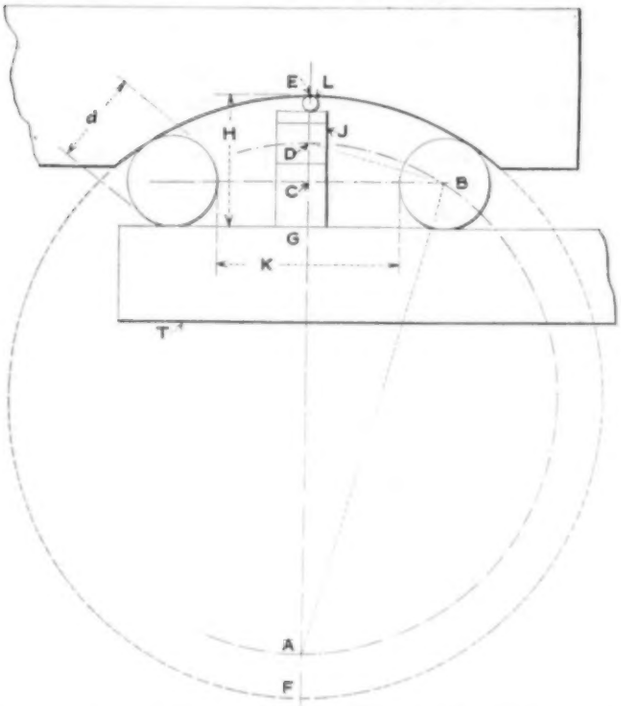


FIG. 8. DIAGRAM FOR DERIVATION OF FORMULA FOR RADIUS OF A SINGLE CONCAVE CIRCULAR ARC

For a convex arc the known dimensions may be denoted as shown in Fig. 9 and the formula becomes:

$$R = \frac{1}{2}\left[\frac{(M-d)}{4(d-J)} - J\right].$$

The derivation of the formula is analogous to that of the previous one.

If the buttons cannot be conveniently clamped to a surface plate or otherwise held at an appropriate distance apart it may be well to clamp the buttons to the templet itself, in which case it is necessary merely that the two buttons be located equidistant from the arc in order to determine the radius with a minimum of calculation. In this case it will be advisable to arrange the formula for dimensions taken from the CENTERS of the buttons as sohwn in Fig. 10. The formula is:

$$R = \frac{1}{2}\left[\frac{N}{4(T-S)} + T + S\right]$$

and it will be clear that either of the quantities T or S will be negative if the space corresponding to the dimension is on the convex side of the primary arc.

When using trigonometrical tables the labor of interpolation is naturally to be avoided as much as possible; in fact, it is generally better to have a table unnecessarily large than to be obliged to use one which is inconveniently small. It is commonly expedient to

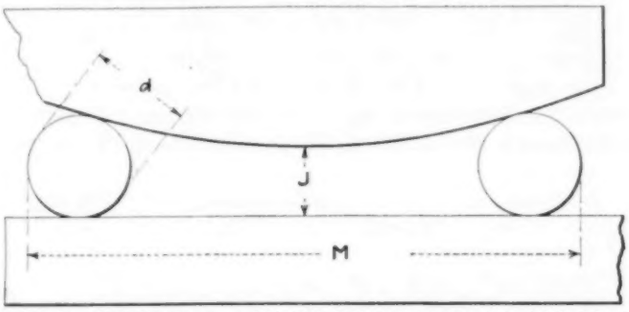


FIG. 9. METHOD OF MEASURING TO FIND RADIUS OF A SINGLE CONVEX CIRCULAR ARC

extend the decimals of a calculation somewhat further than might be strictly warranted by the degree of precision actually attained in the construction of a gage or in the means for checking it, hence it may be of interest to mention Bauschinger & Peter's table of logarithmic sines and tangents to every second (G. E. Stechert & Co., New York).

As the numerical value of the distance between the centers of the pins is to be used repeatedly as a divisor, if the calculator is not familiar with logarithms he should use the reciprocal of this value as a multiplier. Let AB represent the value of the distance between the pin centers. When the decimal equivalent of $1/AB$ has been found by division or from a table, it should be added to itself repeatedly so as to get a small multiplication table such as shown in Table II, which will both save labor and tend to avoid some of the chances

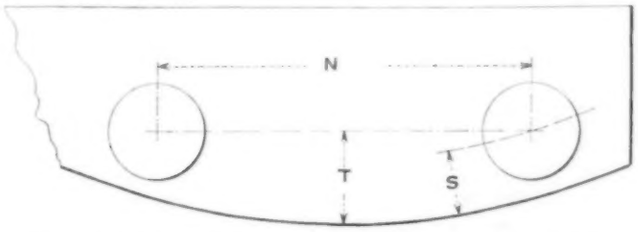


FIG. 10. MEASURING TO FIND RADIUS OF A SINGLE CONVEX CIRCULAR ARC WITH BUTTONS CLAMPED TO THE TEMPLET

for errors to intrude. If an adding machine of suitable type is available it may be worth while to extend such a table to 100 times $1/AB$.

It will be noted that for each individual measurement of a point on a curve nothing is required in the way of calculation more difficult than addition, subtraction and multiplication and in comparison with a method of curve measurement which necessitates either division or the extraction of square root, certain advantages of the tangent method for the inexperienced calculator will be appreciated.

TABLE II. MULTIPLICATION TABLE FOR CONSTANTS

1	0.0133314
2	0.0266628
3	0.0399942
4	0.0533256
5	0.0666570
6	0.0799884
7	0.0933198
8	0.1066512
9	0.1199826
10	0.1333140

The calculations may be checked by working to a point P on the profile from both pins; or if a more rigid check is desired three pins may be used instead of two,

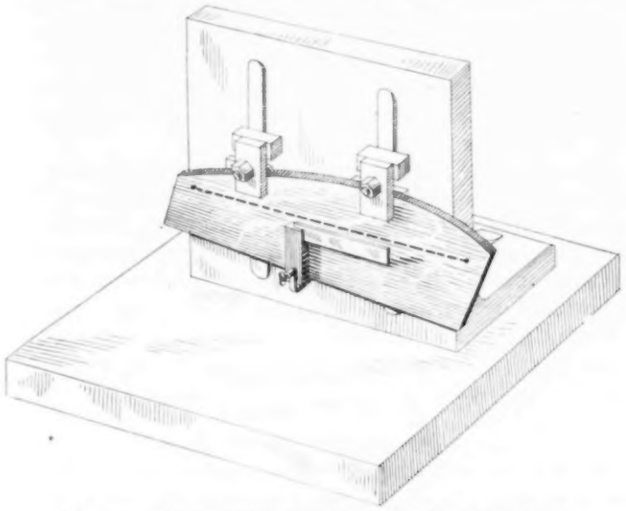


FIG. 11. FIRST STEP IN MEASURING DISTANCE BETWEEN PIN CENTERS

the third pin being located midway between the end pins in which case the condition of the profile at any point P would be found from the end pins and this result checked by using the middle pin and one of the end pins. Of course four pins could be used, two at each end of a profile, to permit different pairs of pins to be used independently for the most rigid checks on all the measurements and calculations involved in machining a profile and locating parts of a gage in proper relation to it, but in the case of a mere templet, after the locations of the two pins have been carefully determined, it may not be worth while to check any of the later calculations. If the curves are reasonably smooth and the readings are not too far apart any single error in measurement or calculation will be disclosed by an abrupt variation in the results in column R and the uncertainty of such an occurrence is quickly and conclusively settled by taking a second reading near the point in question.

The number of readings to be taken on any particular curve will naturally be regulated in the main by the

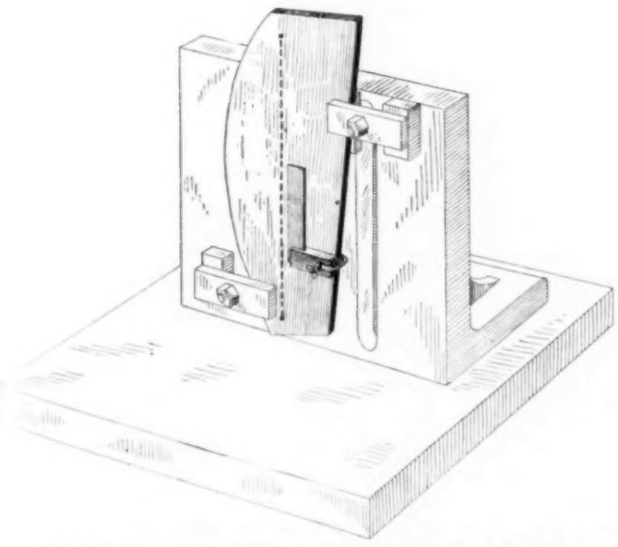


FIG. 12. SECOND STEP IN MEASURING DISTANCE BETWEEN PIN CENTERS

character and prevalence of its errors. If the curve has been finished by hand operations or is otherwise liable to erratic variations, about the only course to be followed is to take readings on the curve at convenient points and to continue the routine until the results leave no serious uncertainty; but if there is some warrant for presuming that the curve is a very good approximation to a circular arc it may be well to inspect this property of the curve first and afterward to take only a few readings by the tangent method to determine the position of the curve relative to other curves of the profile or other parts of the device. By fixing two pins or temporary lugs about as far apart as half the length of the arc and then sliding the arc along these points, with a stationary indicator touching the arc not too near either of the lugs, it may be possible to ascertain with practical surety that the arc is truly circular within the desired tolerance if such actually is the case, but unless the arc is smooth and true the test is likely to afford only negative results.

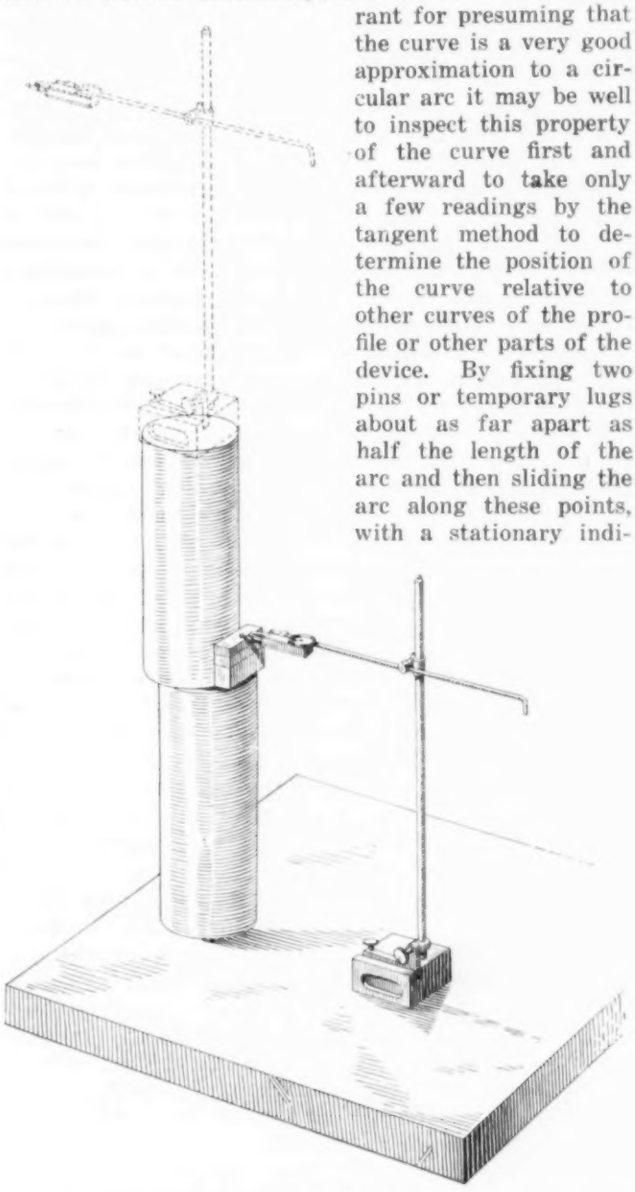


FIG. 13. THE USE OF SIZE BLOCKS AND INDICATOR IN MEASURING DISTANCE BETWEEN PIN CENTERS

As it is plainly a difficult matter to determine with certainty and precision the distance between two pins or buttons which are comparatively far apart, a word of warning may be allowed regarding the dubious value of the micrometer or vernier caliper in such cases in contrast to the dependable results which are secured with indicator and size blocks. If pins are a foot or more apart it is most difficult to judge the character of the "touch" when using an ordinary outside micrometer. Without asserting that it is impossible in such a case to reduce the probable error of a reading to less

than one one-thousandth, the manifest uncertainty in the touch should disbar the use of such a tool if it is desired to keep the error within this limit.

If a templet is clamped to an angle plate resting on a surface plate as indicated in Fig. 11 an ordinary square may be clamped to the templet and the templet and square adjusted until one edge of the square is parallel to the line of centers of the construction pins. While keeping the square fixed to the templet, if the templet is held vertically, Fig. 12, an indicator on the second blade of the square will show when the pin centerline is vertical and then measurements from the pins to the surface plate made with indicator and size blocks are both precise and reliable. As a moderate error in the vertical direction of the pin centerline would cause merely a negligible error in the measurements the operation of getting the pins in vertical alignment may be done hastily with only moderate pains.

If there is available—as there should be in every tool shop—a size block large enough laterally to permit a surface gage to be placed upon it, the combination may be used as indicated in Fig. 13. In this manner with careful handling the surface gage can be moved from the top of the block to the surface plate and back, thus comparing the height of the pin above the block with the height of the Johansson blocks above the surface plate. While inspecting a long tool the writer has used a surface gage in this manner on a pile of three steel size blocks with the indicator in operation at a height of more than four feet above the surface plate. In this instance it was necessary to minimize vibration by placing a rubber block under each pad of the surface plate but with such concession the results were entirely satisfactory.

When it is desirable to stretch available facilities to reach a high button it is clearly sufficient to reach the lower edge of that button and in doing this a couple of inches of the height can be saved by using the indicator upside down (with a mirror to assist when reading the dial) in which case the Johansson blocks would be arranged with the ball of the indicator functioning on the under side of the topmost of the blocks.

In passing, it is tempting to emphasize the convenience and usefulness of such size blocks in general tool inspection work and to express the opinion that any inspector who has once used them would be most unwilling to do without them. If available tools cannot reach between the pins of a curve inspection job it may be practicable to place one or more buttons in line between the pins and measure the total distance in sections. Such a procedure should not make trouble if the part is light.

If the curves belong to a device which is so heavy as to be moved only with difficulty the dependability of the indicator and size blocks method may even warrant the expedient of placing the heavy tool in a position such that the pin centerline is roughly vertical, placing by the side of the heavy part a surface plate supported by adjustable jacks and then moving the surface plate until its surface is perpendicular to the pin centerline. In some cases it may be advisable to clamp an angle plate to the heavy part, to clamp a second angle plate to the first and to adjust these until a surface is perpendicular to the pin centerline.

At the present stage of toolroom practice it is probably very seldom that an occasion arises when it is desired to inspect with considerable precision a curve which was not intended to be an arc of a circle, with an exception perhaps, in the case of the involute.

It would be possible of course to inspect any curve by placing a cylindrical plug or a spherical ball in contact successively with different points of the curve if means are available for determining the several positions of the convex plug or ball, but, except in the case of a circular arc, the incidental calculations would be apt to stagger anyone but a thoroughly experienced computer, so that the tangent method is to be preferred in the case of any irregular curve.

The tangent method is applicable to an involute of a circle, commonly termed simply an involute. The calculation required is not too seriously troublesome and the formulas appropriate for an inspection of the involute may be derived along the same general lines as followed for the arc of a circle.

Precision Gages

By H. W. Bearce
U. S. Bureau of Standards

In the article by M. E. Kanek under the above title on page 884, Vol. 53, of the *American Machinist*, a list of recommended sizes is given which it seems to me is open to objection.

First, of the 30 sizes given, 22 are so thin as to be at present not commercially practicable. It has been found by experience that a block of about 0.05 in. thickness is as thin as can at present be produced commercially. It is, of course, a simple matter to make blocks as thin as desired; but to make them with plane and parallel surfaces, and keep them in that condition, is quite another matter.

Another point that might well be raised is the advantage of the 1, 2, 4, 8 series recommended by Mr. Kanek over the more usual 1, 2, 3, 5 series. The two are of equal value as far as making up combinations is concerned.

Sets of less than 81 blocks are, of course, already in use.

The usual sizes of the 34-block set are as follows:

0.10025			0.10050			0.10075		
0.101	0.102	0.103	0.104	0.105	0.106	0.107	0.108	0.109
0.11	0.12	0.13	0.14	0.15	0.16	0.17	0.18	0.19
0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
1.	2.	3.	4.					

If, for any reason, the above sizes are unsatisfactory, the following is suggested as containing a somewhat smaller number of blocks and at the same time as being commercially feasible.

0.0501	0.0502	0.0503	0.0504	0.0505	0.0506	0.0507	0.0508	0.0509	
0.50	0.051	0.052	0.053	0.054	0.055	0.056	0.057	0.058	0.059
0.11	0.12	0.13	0.15						
0.1	0.2	0.3	0.5						
1	2.	3.	4.						

The above series makes a total of 31 blocks. This number could be reduced to 26 by omitting the 0.054, 0.056, 0.057, 0.058 and 0.059, and to 21 blocks by omitting the 0.0504, 0.0506, 0.0507, 0.0508 and 0.0509. Such a reduction, however, is not advisable as it would greatly increase the number of blocks required to make up certain sizes.

Mr. Kanek's statement in regard to lack of agreement among scientists as to the wave length of light appears to be a rather weak attempt to discredit the optical method of testing. Until the art of manufacturing precision gage blocks is much further advanced than at present, no one need concern himself greatly about inaccuracies in the wave length of so-called monochromatic light from the usual sources such as the helium tube or the sodium flame.

Special Railroad Machine-Forging Tools

Description of Dies Used for Forging Locomotive Grease Cups, Universal-Joint Jaws, Connecting Rods, Valve Handles, Boiler-Flue Beading Tools, Etc.

By J. V. HUNTER
Western Editor, *American Machinist*

A CONSIDERABLE degree of success has been obtained in tooling the different forging machines of the locomotive blacksmith shop of the Wabash Railway Co. at Decatur, Ill. A forging-machine die with few complications is shown in Fig. 1; it is used for forging the blank *A*, from which locomotive grease-cups are machined. The forging is made from round bar and the stock is gathered in the upper pass of the die where it is upset while still retaining its roundness. In the lower pass *B* the material is further upset, formed to a hexagonal section and, at the same time, the point *C* of the header squeezes the major portion of the stock from the center of the blank. This leaves the hollow center shown in the forging and saves the time of drilling it out during the subsequent machining operations.

Forging Universal-Joint Jaws

The universal-joint jaw shown at *A*, Fig. 2, is a good example of light, intricate machine forging. It should be noted that the shank is pierced with a square hole which adds one forging operation. In working out this forging the stock is first necked down in pass *B* leaving the material which later forms the forging in the section inclosed by the dies. This necking-down operation insures that all stock required for the forging will remain in the die and prevent any slipping back through the grips. The outer end of the stock thus gathered is then flattened by gripping between the dies in the pass *C*.

The next two passes are practically identical, rough-forging the jaws first in the bottom pass *D* and then finishing them in the middle pass *E*. The header *F* is for the pass *E* and is somewhat similar to that used for the bottom pass, which was not available when the photographs were taken. The hole through the shank is punched in the top pass *G* by the square punching header *H*. The necking-down operation which has previously been mentioned provides a small section of the same area as the square-hole punch so that when this punch has made its stroke the finished portion is free from the bar. The greatest forging strain on the dies comes where the bar has been necked down, and it will be noted that an insert *I* of special forging-die steel extends through both dies at this section.

Forging a Bell-Ringer Connecting Rod

The Bell-ringer connecting rod *A*, Fig. 3, has a small pair of jaws that are made by a different method. The side of only one of the dies for this operation is shown. Three passes are required, starting with the gathering

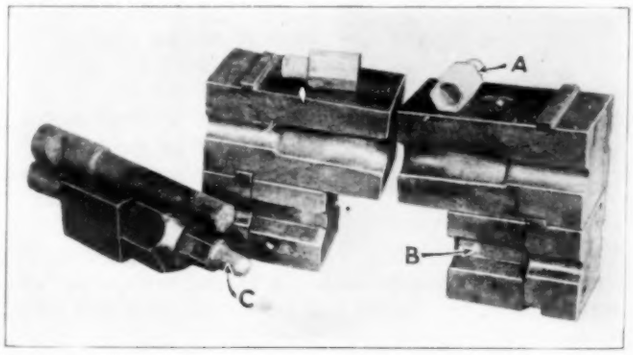


FIG. 1. BLANKS FOR LOCOMOTIVE GREASE CUPS FORGED IN TWO PASSES

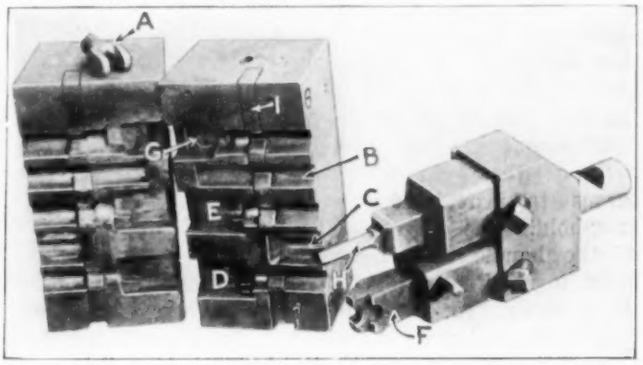


FIG. 2. FIVE-PASS DIES FOR FORGING UNIVERSAL JOINT JAWS

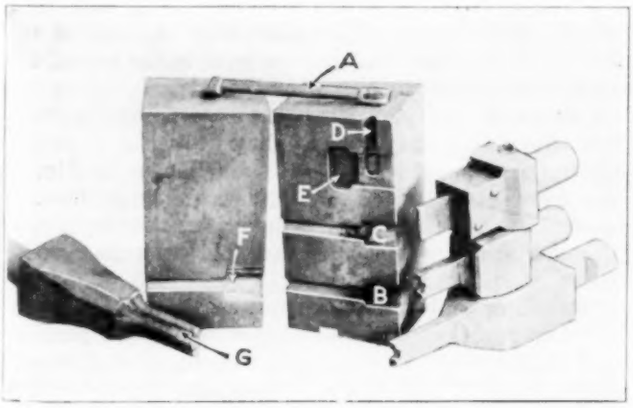


FIG. 3. FORGING DIES FOR BELL-RINGER CONNECTING ROD

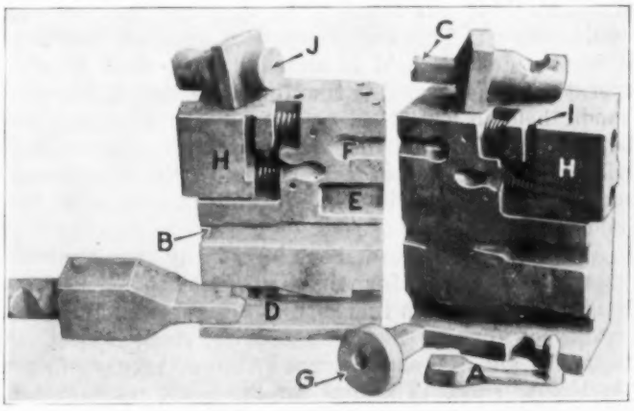


FIG. 4. DIFFICULT VALVE HANDLE FORGING MADE IN HEADING AND SLIP DIES

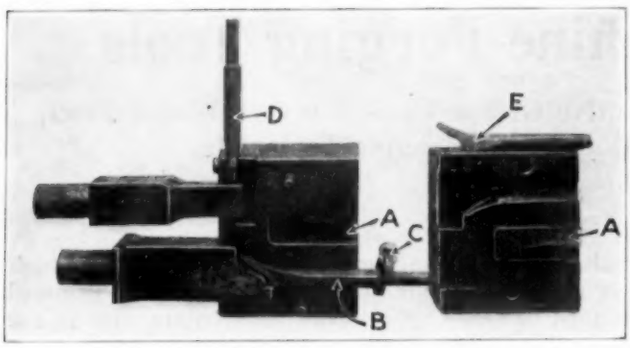


FIG. 5. DIES FOR BOILER-FLUE BEADING TOOL FORGINGS

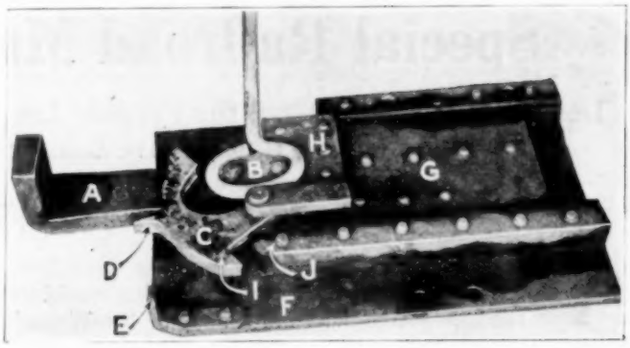


FIG. 6. WING DIE FOR BENDING LOOP HANDLES

of the stock in the lower pass *B*. The jaws are shaped further in the pass *C* and are then held in a vertical position in the pass *D* while the top header punches out the stock from between the jaws, carrying it through into the space *E*. The other side of the die blocks is used for the single pass required to form the other end of this forging. This is a simple upsetting operation in the pass *F*, using the header *G*.

An exceptionally difficult piece to accomplish on a forging machine is the valve handle shown at *A*, Fig. 4. The hub or shaft end of the handle is the first portion upset and the stock for this is worked partly to shape by an upsetting operation in the pass *B* using the header *C*. This end is then inserted in the bottom pass *D* where the header shown forges it to its final form exclusive of flash trimming operations. It will be noted that the rear end of the dies (where they adjoin in the illustration) shows an enlargement of this pass back of the grip which serves to provide for a tong-hold. The formation of the handle end shows great ingenuity as this is a difficult shape to forge in this manner. Its end is first worked down to small section by several gripping blows in the pass *E* and then shaped up in the same manner in the pass *I*. Originally an attempt was made to give a right-angle bend in a form bolted to the top of the dies, but the gripping blow of the machine was found to be so severe that the end would snap off. This end is now bent by hand, inserting it in the stake *G* held in an anvil. The final forging operation is performed in the slip-die section *H* with the handle held in a vertical position in the groove *I*, the bent portion for the handle lying in the impression that will be noted. The header *J* pushes in the two slip-die sections, thus upsetting and forming the base of the handle.

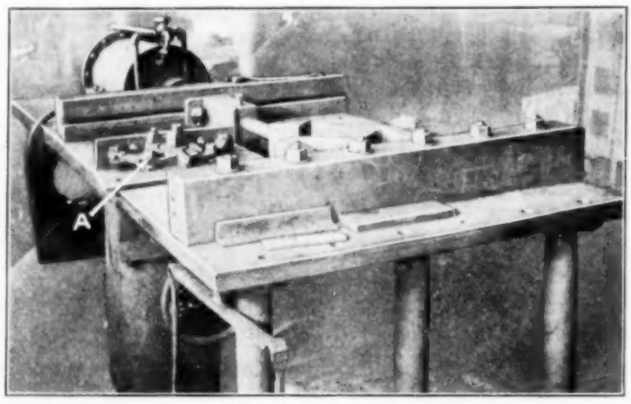


FIG. 7. AIR-CYLINDER BENDING PRESS AND SPECIAL DIES

A number of railroad shops have lately been devising improved methods for the production of boiler-flue beading tools, and in this shop is found a well-developed method of forging these. The chisel stock is first cut to length and the shank turned before these go to the blacksmith shop. The dies for the work are shown in Fig. 5. The first operation is to flatten out the end in the center pass *A*, which is merely a squeezing operation. Unfortunately the die at the right has been turned upside down and is a little confusing.

The first flattening operation leaves the end so that it is in good shape for the forming operation in the bottom pass *B* that forms the tool as shown. An end view of same is shown at *C*. For the final operation the piece is held vertically in the position *D* while the header of the top pass trims off the flash, leaving the tool as shown at *E* ready for finishing in the toolroom. A peculiar form of wing or folding die is shown in Fig. 6. This die is used for forming the handle of stoking bars, one of which is shown lying in the die. The male part of the die *A* carries the core *B* around which the handle is formed. When this part is withdrawn to the extended limit of its stroke the wing section *C* is thrown back so that the horn *D* comes against the stop *E* rivited to the base-plate *F* of the sliding section. The sliding section *G* operates in guides made by riveting bars to the base-plate, and on its forward end carries the female section *H* for forming one side of the handle, together with the hinged section *C*. The heated end of the bar is laid across the dies and when these close the center core *B* catches it, pushing it into the curve of *H* until, as the sliding section retreats under pressure, the swinging arm *C* swings around, forming the end of the rod around the center core. The forward movement of the die head is arrested at the same time that the horn *I* comes in contact with the end of the slide *J*, which causes the wing to force in the end of the handle with a final firm pressure.

Another pair of plain dies that operate on the well-known toggle-arm principle is shown lying at *A* on the bed of the homemade bending press shown in Fig. 7. This press is of interest because it was made in the shop and consists of a heavy air cylinder together with sliding and stationary heads, all mounted on a heavy base casting.

Attention is also called to the V-block bending dies in use on the machine and particularly the peculiar form of the male V-block which is mounted in a special socket holder. This holder is made so that by means of spacing or filling washers, the male V-block may be easily adjusted for different thicknesses of stock.

Convenient Shipping Crate Diagram for Machinery

SPECIAL CORRESPONDENCE

A good method of crating machinery, of showing exactly what material is required and the way in which it is put together, is shown in the accompanying diagram. This is the practice of the Blanchard Machine Co., Cambridge, Mass., the diagram having been arranged by the superintendent, Winfield W. Blake. The machine shown is a 16-in. high power vertical surface grinding machine.

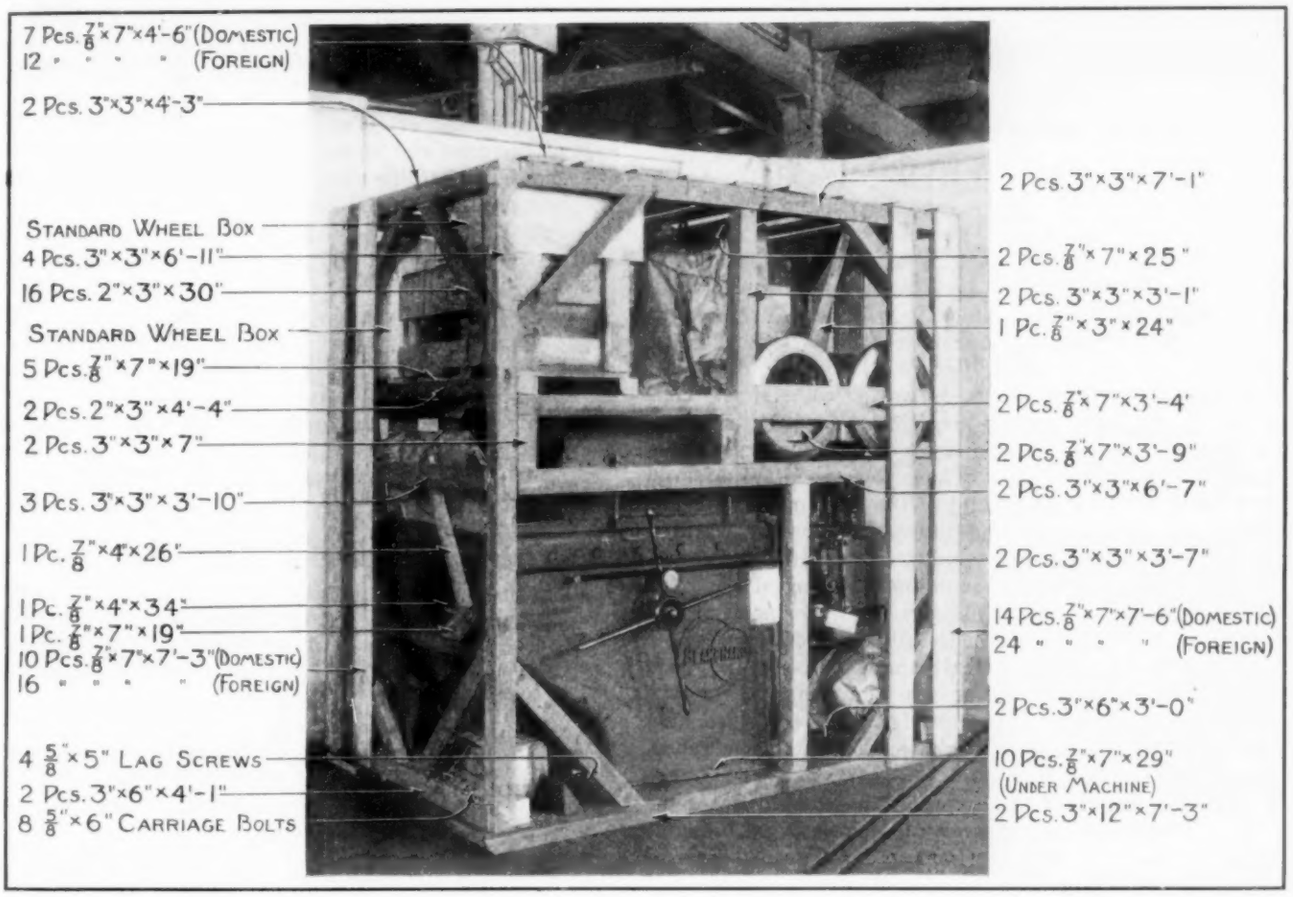


DIAGRAM OF CRATE CONSTRUCTION AND LUMBER USED

A copy of this diagram goes to the lumber merchant together with the instructions that "all frames, braces and skids are to be of spruce and all 7/8 in. stock is to be of North Carolina roofers." This diagram enables the lumberman to send stock which will cut up economically to the lengths shown and so secure the necessary pieces of lumber with the least possible waste.

It will be noted that there are three references to domestic and foreign shipments. The additional number of pieces shows what is required to make it a complete box, such as is used for foreign shipment.

Such a diagram can be readily made for almost any type of machine and forms a simple yet comprehensive record of the kind and amount of material required, as well as the way in which the crate is built up. This method seems particularly useful in comparatively small shops where standard machines are built, so that it has a wide field of useful application.

Computing the Depth of Keyway in Gear and Pulley Hubs

BY HENRY R. BOWMAN

I have noticed several articles in the *American Machinist* in regard to finding the depth of keyways in pulley and gear hubs, but they involve the use of tables which are apt to be mislaid when required for use.

The following rule is simple and easily memorized:

$$X = \sqrt{\left(\frac{D}{2} + \frac{W}{2}\right)\left(\frac{D}{2} - \frac{W}{2}\right)} + \frac{D}{2} + \frac{b}{2} + .002$$

X = the required distance from the bottom of the keyway to the opposite side of the bore of the hub.
D = diameter of bore.
W = width of key.
b = thickness of key.
0.002 = clearance.

Extracting Small Slivers of Steel

BY J. A. RAUGHT

I suppose every machinist has his way of removing steel slivers. In most cases they are likely to locate them first with the eye, then proceed with the scriber, knife blade, or some other similar implement.

The method I use I think is superior to others: Get a safety razor blade—one that is clean and quite sharp; scrape the part quite hard once or twice where the sliver seems to be, and then examine the edge of the blade where, most likely, you will find the sliver.

Generating a Parabolic Reflector

BY L. J. VOORHEES

Some time ago I was confronted with the problem of experimentally making a number of small, accurate, parabolic, thin metal reflectors of various depths and the method finally adopted facilitated this difficult job to such an extent that I believe it will be of interest to others, and perhaps can be used to construct other sheet metal articles of a similar nature.

The method previously used was to geometrically construct a parabola on the drafting board by the use of a large number of ordinates with their respective mathematical dimensions. These were then transferred to a sheet of thin metal and a line drawn through the points of intersection was the parabolic curve which formed the outline of the templet from which the reflector was later constructed. In using this method a number of unavoidable errors or inaccuracies were incorporated which were objectionable in the finished reflector. Also the method was slow, difficult and expensive and even when considerable care was used in constructing the templet the inherent inaccuracies were objectionably noticeable in the beam of light projected by the reflector made from it.

The aim was to find a method that would overcome these objections, require very little of a draftsman's time and be easy for a toolmaker to follow. This was accomplished by generating the parabolic templet. I will describe how this was done but will not give the geometric reasons for taking each step, as they are obvious.

A piece of well seasoned, hard maple, somewhat larger than the diameter of the finished reflector, was placed in a three-jaw, universal, bench lathe chuck and the end turned down to provide a more positive grip for the chuck-jaws, as shown in Fig. 1. The piece was then removed and the turned end placed in the chuck and firmly gripped. The part outside of the chuck was then turned to the exact diameter the finished reflector was to be. The end was then pointed until it formed a cone. The length of the cone indirectly determined the depth of the reflector. I will explain this after the next step. The positions of the chuck-jaws were marked on the block so that after being removed it could be put back in the same concentric position. It was then removed and placed in a milling machine vise in such a position that a thin saw would cut the slot *ed*. This slot was cut about 0.025 in. wide being started exactly in the center between the points *a* and *b* and continued parallel to the side *cb* until it reached the base of the cone at *e* exactly in its center. Care was taken to cut just to the base of the cone and no further. I would like to emphasize the fact that the slot *ed* is exactly parallel to the

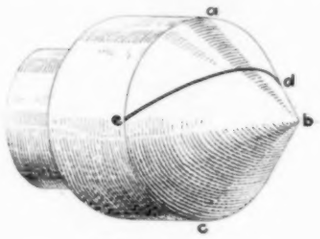


FIG. 1

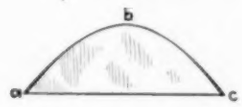


FIG. 2

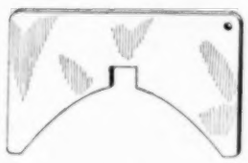


FIG. 3

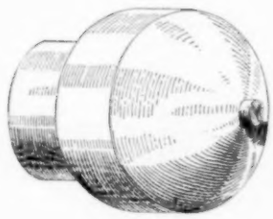


FIG. 4

FIG. 1. HARD MAPLE BLOCK IN WHICH THE MALE TEMPLET WAS MADE. FIG. 2. THE MALE TEMPLET, FINISHED EXCEPT FOR FILING THE BEVEL. FIG. 3. FEMALE TEMPLET. FIG. 4. THE SPINNING BLOCK

side *cb* of the cone and where the slot touches the base of the cone it lies exactly in its center line.

I will now explain how the dimensions of the cone are determined. As already stated the diameter of the base of the cone will be the diameter of the finished reflector. The depth of the slot *ed* will be the depth of the reflector. As the depth of this slot is one-half the length of either of the sides *ab* or *bc* then the depth of the reflector will be one-half the length of either side of the cone.

With this cone we generated the parabolic templet in the following manner. A piece of sheet metal with at least one straight side was fitted tightly into the slot *ed* with the straight side lying against the bottom of the slot. A line was scribed on the metal along the edge of the slot; the metal was removed and the edge trimmed off so that when it was put back in the slot just a small amount protruded the whole length of the slot. Then the piece of wood, with the sheet metal still in the slot, was inserted in the lathe chuck in its original position. The lathe was started and while the block slowly rotated the metal that protruded from the slot was carefully removed with a fine file. When the edge

of the inserted sheet metal exactly conformed to the contour of the cone it was removed from the slot. This completed the male templet.

When the templet is generated with a cone having an included angle of less than 90 deg. in its apex the templet, when viewed from the side, as shown in Fig. 2, will have an edge that bevels toward the back at *b*, and toward the front at *a* and *c*. The direction of the bevel at *b* should be reversed by filing down the edge that is high, so that it bevels toward the same side throughout its entire length.

In order to make a block over which to spin the reflector it was necessary to have a female templet or gage Fig. 3. This was made by cutting out a piece of sheet metal and accurately fitting it to the male templet. A piece of seasoned hard maple was then turned to fit the female templet and the reflector was spun over this block, suitably trimmed and silvered. The finished spinning block is shown in Fig. 4.

In making the female gage the difficulties are very much lessened if the metal used is several thousandths thicker than that used in the male gage. In fitting them together a piece of plate glass to lay them on makes the matching much easier. The two templets can be placed together on the glass and then be held up to the light, glass and all, or the glass can be clamped so it extends over the edge of the bench. When used in this position a light should be placed under it.

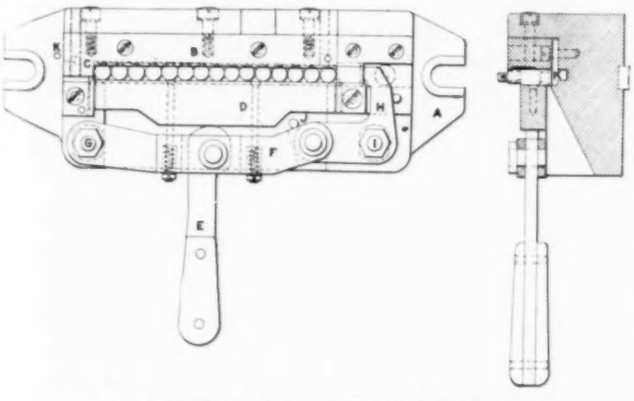
It was found that parabolic templets constructed in this manner were more accurate than required for these thin, drawn, sheet-metal reflectors, and that reflectors made from these templets were more accurate than when made the old way and that this improvement was especially evident in the concentration of the beam of light reflected.

Multiple Fixture for Milling

BY FRED S. WOODEAD

The illustration herewith shows a good quick-action fixture for holding a number of pieces for simultaneous operation on the milling machine. It is designed to reduce the time of unloading and reloading as much as possible.

The base *A* of cast iron, has screwed and dowelled to it the stationary jaw *B*, of hardened steel. This jaw has an angular projection at *C* that serves as a stop to resist the thrust of the milling cutter. The moveable jaw D, also of hardened steel, is operated by the cam lever *E*, the latter having its fulcrum in the link *F*, which in turn is pivoted at *G* upon a stud fixed in the base.



FIXTURE FOR MULTIPLE MILLING

The opposite end of the link *F* is attached to a bent lever or bell-crank *H*, pivoted upon the stud *I*, also fixed in the base, and the opposite end of the bell-crank *H* exerts a longitudinal thrust upon the work, holding it firmly against the stop *C;* thus clamping the work in two directions at a single movement of the handle.

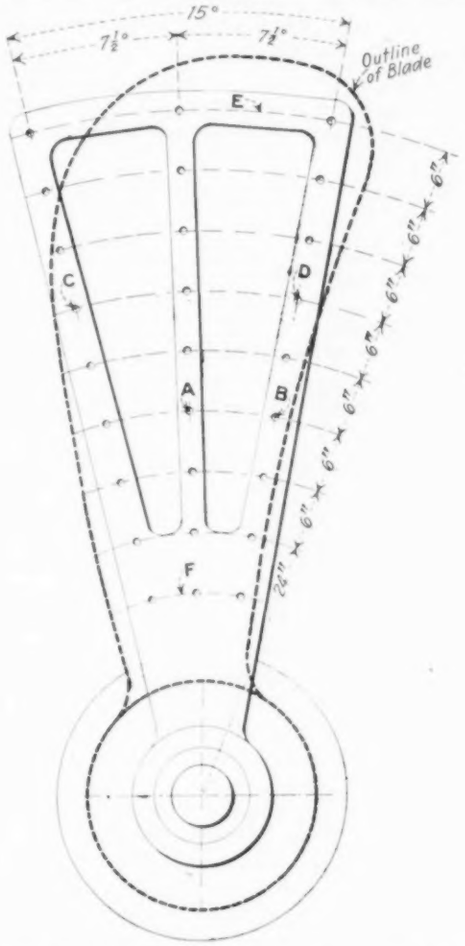
Tension springs attached to the movable jaw *B*, and having a bearing upon the first link *F*, tend to throw the fixture open as soon as the pressure of the cam lever is released. A pin at *J* limits the movement of the links when the jaws are opened.

A raising block is provided at *K* upon which the work rests, and other blocks of the same shape but of different thickness may be supplied to suit the dimensions of any work that may fall within the range of the fixture.

Measuring Propeller Blades

BY JAMES MCINTOSH

Referring to an article on page 706, Vol. 53, of the *American Machinist* under the above title, I have to say that the *modus operandi* evidenced by the description



DEVICE FOR MEASURING PITCH OF PROPELLER BLADES

given will never indicate the "pitch," as I know it; that is, the distance the boat will advance per revolution of the propellor (slip being neglected).

I inclose a sketch of a device that is used in Scotland and by its use it is a simple job to find the pitch without calculation. Assume a frame incorporating three rows of holes drilled on radial lines 7½ deg. apart, the first holes starting at some point say 18 in. from the center of the propeller hub and the other holes

say 6 in. apart; the holes so spaced will indicate the pitch at every foot in diameter.

The angle between the arms of the pitchometer frame is in this instance 7½ deg., the included angle being 15 deg. This gives $\frac{1}{48}$ and $\frac{1}{24}$ of the whole circumference. As we have decided to use the above fractions of the circumference, the reading bar must be graduated to read ¼ in. = 12 in. and ½ in. = 12 in. respectively so the scales will indicate $\frac{1}{48}$ and $\frac{1}{24}$ part of the pitch; thus the pitch values at any point may be read direct. Assume the pitch at *A*, *B* is desired. The holes being 7½ deg. or $\frac{1}{48}$ part of the circumference, apart, we must use the ¼ in. = 12 in. graduations on the reading bar to get the pitch in feet beween the points *S*, *A* and *B*. It is also obvious that if we take the pitch at *C D* the holes being 15 deg., or $\frac{1}{24}$ of the circumference, apart, we must use the ½ in. = 12 in. graduations on the reading bar.

The frame is often made of wood for lightness and is fitted with a series of holes as indicated to fit bushings that are unusually long to keep the reading bar (say a ⅜-in. steel rod) square with the plate or frame. The top of the bushings should be all the same height and the rod should have a long fine point to strike the face of the blade so as to give a true reading.

It is usual to use the propeller nut to pinch the frame against the hub and bring it square with the center line of the shaft.

Suppose we insert the rod graduated ¼ in. = 12 in. in hole *A* and the reading is 8 graduations, and after transforming the rod to hole *B* the reading is twenty-four graduations, the difference being 24 — 8 = 16 ft. or the pitch of the blade between points *A* and *B*. Considering the points *C* and *D:* if the pitch is uniform, the difference in rod reading will be double due to the points being 15 deg. apart, and it is obvious we must use the graduation ½ in. = 12 in. which should also indicate 16-ft. pitch.

By using the holes at both 7½ and 15 deg. we may detect a blade that has an increasing pitch from leading edge to trailing edge or where the pitch increases from root to point of blade as at *E* and *F*, etc. To use the rod along the radial lines of holes we may determine if the face is at right angles to the center line of the propeller shaft or if it is thrown back to aid in driving the water more directly astern. If the pitch is square the rod reading will be the same in each radial hole; if it is thrown back (usual for high speed boats) the amount is the difference of the reading, using the radial lines of holes.

[The author of the article in question states that in the use of the word "pitch" he intended it to mean the relative squareness of the blades with the shaft and not the helical pitch or lead.—EDITOR.]

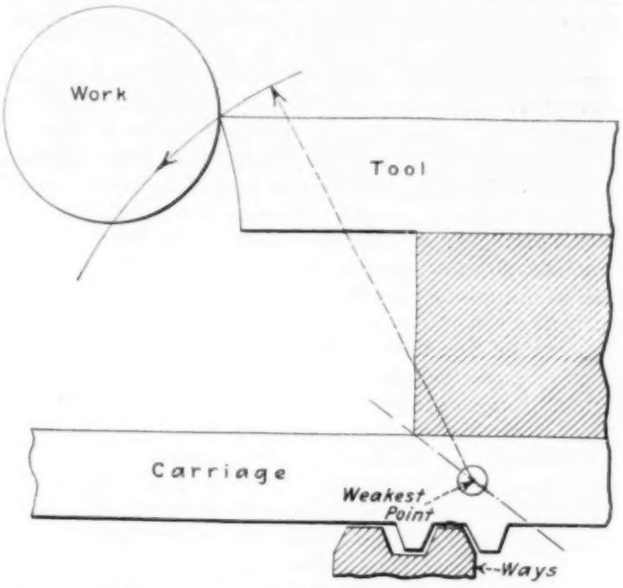
Know Why You Do Things

BY A. W. FORBES

On page 883, Vol. 53, of *American Machinist*, L. S. Watson asks my reasons for placing a lathe tool below center. I am not a machinist, and Mr. Watson can probably get a more satisfactory answer from a specialist in machine-shop practice, but in connection with my electrical work I have found it necessary to know something about lathe work.

One of the reasons, a condition which I have repeatedly met, is shown by the appended sketch. Details of construction have been omitted, and the lathe design so distorted as to illustrate the principle. This shows a tool of massive proportions, rigidly mounted, and a carriage relatively weak. As the chip exerts a pressure downward on the tool the carriage bends forward on the arc shown, so that the tool digs in, giving an unsatisfactory finish.

When this trouble develops there are several easy remedies. One is to use a weaker tool, so that the tool



SHOWING ACTION OF TOOL UNDER PRESSURE OF CUT

will bend away from the work as much as the carriage bends forward. The sketch shows that it must bend away many times as much as the carriage bends forward. I have also used spring tools for this purpose. Usually the best remedy is to lower the tool till the digging in stops, the point being easily found by trial.

In the great majority of cases the motion of the tool is away from the work when placed on center, so trouble does not develop.

[In the original article upon this subject, published on page 612, Mr. Forbes advances the idea that the cutting point of a lathe tool should be below the level of the center line of the lathe. Being contrary to the training and observation of thirty-five years of experience the proposition was new and somewhat startling to us; but as we reflected, old theories are being upset, old practices discarded every day; why not this one? Our opinion is that, however, in putting the idea into practice, insurmountable obstacles to good work in the way of faulty clearance angles and negative top rake would be ecountered and that any advantage that might accrue in the way pointed out by Mr. Forbes would be far more than offset by the introduction of complications due to backlash of the crossfeed screw and nut. We still believe that we would prefer to set the point of a lathe tool, not on the center-line but above it. Can any of our readers show us our error?—EDITOR.]

Position and Help-Wanted Advertisements

BY JOHN MARK MAY

In the article "Getting the Right Man Through the Help Wanted Columns," by A. W. Forbes, on p. 892 of the *American Machinist*, there is one paragraph about

which I would like to ask the question, Who is to blame? The paragraph referred to is the one that makes mention of a blind advertisement from which a good number of replies were received, not one of which showed that the writer had any of the qualifications called for and not one of which the advertiser considered worth a reply.

Is it not a fact that many of the advertisements for help ask for a higher grade man than they expect to get or pay for? The writer feels sure that some of them do.

In one case that came under my observation an advertiser made the remark that he was advertising for first-class toolmakers, not that he wanted them but that by so doing he would be likely to get replies from handy men and fairly good machinists, both of which he did want. Now I ask the question: Has there not been so much of this kind of advertising done that at the present time those who are looking for help and those who are looking for jobs are adopting as their regular practice a certain discount on the words of the advertiser and the words of those who answer the ads?

I realize that one of the faults that humanity is heir to is the individual's inability to avoid rating his own talents somewhat higher than he would the same qualities when in the possession of another person, but is it not time that we should all say just what we mean—*especially when we put it in print?* Then the man looking for a job will not answer an advertisement that calls for qualities that he knows he cannot produce, but will answer only those that ask for knowledge and experience which he possesses.

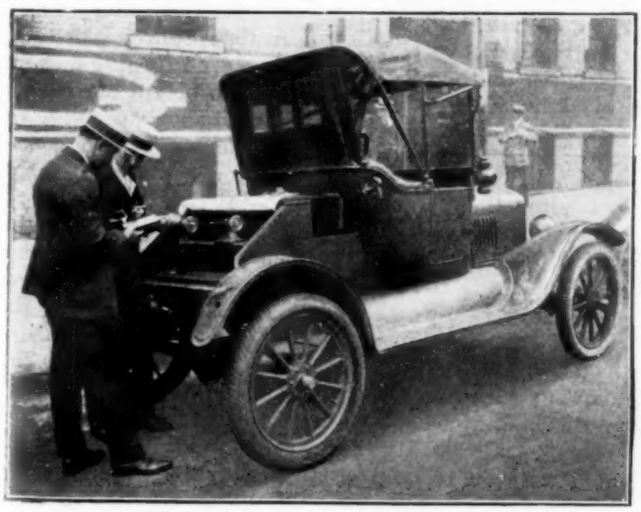
Then he who answers an advertisement can reasonably expect a reply, for inasmuch as fifty applications might be received when only ten men were wanted the advertiser would feel that all of the applicants had responded to his request truthfully and in good faith and that all of them were at least entitled to a reply.

Some Experiences in Selling Machine Tools

By Lambert G. Neff

Sales Engineer, S. A. Potter Tool and Machine Works, N. Y.

I never claimed to be a salesman. It was my job to be humped over a drafting board, designing and detailing machines which our manufacturing department would occasionally criticize.



BENCH LATHE MOUNTED ON THE BACK OF AN AUTOMOBILE FOR DISPLAY PURPOSES

I was busy "sharpening my pencils," as our office boy would put it, when the war started, and my Uncle Samuel reminded me that I was a reservist. After a period in training camp, my business for a year and a half was to be a high-flyer and to teach others to do likewise. It was a case of "there may never be a tomorrow for us, so let's go the limit today." I am telling you all this so that you may understand how it was that, after all the excitement of the war times, I could not come back to the tameness of the drawing board. I told this to the boss when I got back and he said, "I could get out then." I thought at first that I was no longer to draw down that little salary that came in so handy, but he didn't mean what I thought. He said he meant that if I had gall enough to go up in the air, I could use it to land some business for the firm.

It looked like a cinch at first. I knew our product and had seen it built and inspected; and I was convinced that it was the best machine on the market. But for some reason or other, people either didn't want to see me, didn't want to buy anything or were not so sure that our machine was the best. Such a statement by one upon whom I called sometimes led to a little argument.

Now I am like the Allies, I do not want to fight unless I have to. So it occurred to me that I might be able to avoid an argument by taking the foreman to the machine and proving my assertions to him. I did take hold of some foremen and bring them to our shop or to some other shops in their neighborhood where our machines were being used; and in nearly every case where I managed to do so, I made the sale. But I could not drag the fellows along who would not come out. That was my problem.

Since the foremen would not come to our shop, I began to carry the lathe with me. No, I am not saying that I carried the whole machine around in my pocket; but I did take the headstock spindle and the grinding attachment and show them around. But people then wanted to see the whole machine. One day the boss had his limousine standing in front of the factory and I asked him if he would permit me to take a little ride in it for a while, as I had a special call to make. He said, "Go ahead." Of course, I did not tell him or did he ask me where I was going; but he was not pleased when I stayed away with the car most all the day. You see, a certain manufacturing company, which was a prospective customer, is about thirty miles from our shop. The foreman there told me that it was too far to come to our place, so I brought the machine out to them. The order I got was worth the trip ten times over.

The next thing was to get a flivver and fix up a case in the back of the car with one of our lathes in it, as the accompanying photograph shows. I got acquainted with all the fine roads and all the bad ones from New York to Chicago, and then some. I know mud in many varieties. Some folks were nice to me and some weren't. Some came out to look and some wouldn't. There are not many metal-working concerns from New York to Chicago along the main roads that have not seen my flivver and my lathe. I told some of my friends that I'd be back soon again; but if any of them read this, I want to tell them that when I got to Chicago I had so many people to call on that I'm there yet.

IN THIS ISSUE

A DESCRIPTION of the No. 78 surface grinding machine, lately brought out by the Wilmarth & Morman Co., has been given the privilege of opening this number. Features mentioned are the use of two precision screws for adjusting the wheel to the cut, the piping of coolant to both sides of the wheel and the running of clutch and gears in oil.

On this page last week we promised for this issue several one-part articles of merit. The first of these, beginning on page 43, is by Associate Editor Hand, telling of the composition of manganese steel, its behavior after casting and the heat treatment required. The chief virtue of manganese steel is its ability to resist wear. It flows under sufficient pressure and in its flow hardens to a great extent and very rapidly, resulting in a hard wearing surface having a ductile backing. Manganese steel is so exceedingly hard and tough that tool steel will not touch it. The article explains the methods used to machine it and recounts some of the difficulties met.

Fred Colvin continues to draw from his store of data gathered on the Pacific coast. The aluminum alloy piston of the Hall-Scott motor is the subject of the third installment of his series on building motors on the Pacific coast, page 46. He explains the principal operations in making the pistons and presents ample and excellent photographic evidence to back his statments.

The second of the promised one-part articles, page 48, is by W. J. Francke who describes an apparatus for delicate flexure tests and sets forth some results of such tests. Perhaps it is best to use Mr. Francke's own words to show you the "why" of his apparatus and to indicate what you are going to get out of the paper. "The apparatus was designed to test the thin, tempered strip-steel shims used in flexible couplings. These shims are subjected to bending stresses in operation and the apparatus was therefore designed to measure deflection with the idea that the lowest stress at which any change in proportionality of stress to deformation took place could be used as the limiting stress for loading the shims. To accomplish this result, it became necessary to develop and improve the apparatus so that very delicate and accurate measurements could be made." A good technical treatise.

You will feel repaid if you will make the "little journey" with Associate Editor Sheldon this week. He will take you to Pittsburgh, not to interest yourself in steel or smoke or anything else quite so serious, but to go with him down to the river bank to watch engine repairs to a stern-wheeler; to take a trip up the Monongahela, the while examining its locks; and finally to observe some of the extraordinary practices in engine design which are exemplified on the interesting river craft that are designed to meet peculiar conditions.

Elbert O. Brower very thoroughly explains, page 60, a method for the precise inspection of large and irregular curves, by which long arcs of large radii and irregular curves can be inspected in their relations to other working surfaces by taking a series of independent readings at various points along the curves. Only one of the distances which must be measured directly is long, while the others are comparatively short and easily measured with tools commonly available and understood.

"Special Railroad Machine Forging Tools" is the title of a two-page railroad article by Western Editor Hunter, page 67. The railroads are making every effort to get their equipment into good shape, they are employing up-to-date methods in repair and manufacture and they favor the interchange of ideas on shop practice. Such articles as this one on forging dies are going to play a big part in railroad shop efficiency.

Some weeks ago a contributor said several things not altogether complimentary to the average help-wanted advertisement. That started the ball rolling and it hasn't stopped. It seems that many have had somewhat unsatisfactory experiences in answering and composing help-wanted ads. There is a letter on this subject in our section devoted to ideas from practical men, page 70. The same section contains several other short articles that many will appreciate.

Don't overlook "Conditions as the Big Banks See Them," page 80d. In these days of doubt it is well worth anyone's time to keep in touch with the opinions of the big bankers, a large part of whose business depends upon their ability to see ahead.

Coming Features

Last week we announced the series on "Metal Cutting Tools" by A. L. DeLeeuw, and that on "The Foreman and His Job" by Fred Colvin. We just want to remind you now that Colvin's series will start on Jan. 20; that the same issue will contain the second of DeLeeuw's articles, and that both groups should be read from the very beginning.

Beside the two series mentioned there is to appear next week the thirteenth part of W. R. Basset's "Modern Production Methods," devoted to departmentalizing the overhead expense. Productive and contributory departments are defined, incorrect methods of departmentalizing are considered and examples of expense analysis are given.

There are also to be next week several one-part articles that you will hardly class as ordinary. The industrial co-operative course of the high school, Lansing, Mich., is to be explained by E. M. Hall, Lansing's director of vocational education; another apprentice system, that of a railroad shop school, will be treated by J. V. Hunter; and there will be a treatise on the supervision of correspondence by John T. Bartlett.

EDITORIALS

Machinery for Motor Shops

THE future of the automobile industry presents many interesting problems to the machine-tool builder. And these problems are not only interesting—they are vital.

The opinion of those who have studied the situation carefully is that we have probably reached the limit of expansion in automobile building for some years to come. This does not mean that the number of automobiles built is likely to be less, especially after the present readjustment gets things back to normal conditions. It does mean, however, that there are likely to be fewer builders of automobiles and that those who survive must adopt newer, better and more economical methods of machining. It also means that the shops which build the bulk of our automobiles must re-equip in the near future.

This brings up the problem not so much of new machinery as of what kind of machinery? With fewer shops building automobiles greater production per shop must be the rule. This means machinery especially adapted for the work rather than what we usually term standard machines. Will the new equipment be strictly single purpose machines—highly developed semi-automatic, multiple spindle machines, perhaps of the station type—more simple semi-automatic machines with a single work spindle, or hand operated machines of the special turret type? Each has its advocates with convincing arguments—until you hear the other fellow.

The decisions should not and will not be made offhand. They must consider first cost, not only of the machines but of the tools, and interest on the investment. The life of the machine as determined by wearing out in service or by obsolescence is another big factor.

The cost of upkeep—of tooling for different jobs—or of idle time while tools are being ground and reset, must also be carefully considered. The likelihood of lost time from breakdown, or derangement of parts, is an important item. It often looms large in the case of heavy investment in a single machine or a group of machines and may throw the weight of argument in favor of the simpler machines.

The accuracy required is also a determining factor in many cases. The more intricate and the more automatic the machine, the more difficult it usually is to maintain extreme accuracy. The spring of parts frequently due to hard spots in casting can, as as rule, be best taken care of by a skilled operator on a hand machine. And, when we count losses due to stoppages, rejection of parts and other causes, the hand turret machine with a skilled operator is a real competitor.

Where the part is to be finished by grinding, as is becoming more and more common, the need for extreme machining accuracy decreases and acts in favor of the semi-automatic of either type.

But whatever our individual opinion may be, there are many problems to be encountered and solved before the re-equipment of our automobile shops is completed. Millions of dollars worth of new and improved equipment must be installed. Those who are alive to the situation will secure the orders.

Expensive Economy

THE desire to make a "showing" frequently leads us to practice uneconomical methods. The attempt to keep inventories to the lowest possible limit has two sides. Following this plan has led to added expense in many instances.

With the curtailing of automobile buying, many of the builders took drastic measures to reduce the stock on hand and keep the inventory down. Orders for springs, bodies and parts were cancelled where it was possible, or the delivery delayed, to the discomfiture of the parts makers.

In a number of cases, orders exceeded the pessimistic expectation, and parts had to be secured in a hurry. In one instance several carloads of bodies had to be shipped by express, which is no small item of expense when shipments of several hundred miles are involved as in this case. It would have been unnecessary, but for the bugbear of too large an inventory to look well on the balance sheet.

A somewhat different phase of the evil is to be found in the service stations of several makes of automobiles. The stock of spare parts is extremely low in many cases and customers have to wait for service at a time when they should be served well and promptly. The making of spare parts would help to keep the factories going, would help to hold the shop organizations together. And good service to customers is sure to have its effect on next year's sales. Too much economy is sometimes expensive.

The slackening of business, the slump in orders, and the readjustment had to come. You cannot tear the world up by the roots, destroy millions of lives and billions of property without paying the penalty. But it is a great mistake to be too fearful of the future. The world will go on and business will get back to normal. And the sooner we get rid of fear the sooner this will come.

Nothing will help it more than to begin buying what we need in a normal way. As Horace Greeley said years ago regarding the resumption of specie payment, "the way to resume is to resume." The best way to get business back to normal is to begin to buy the things we need when the price is fair, without waiting for them to reach a possible lower price. Such careful buying will induce sellers to make a fair price. But as long as there is no buying many feel that the price does not matter.

This is a good time to show appreciation of fair treatment under the stress of excessive demands. You can do this by placing orders with concerns whose advance in prices but kept pace with their costs. Let those who profiteered learn that fair play and a square deal pay in the long run.

The first thing is to realize fully that business is coming back, that it *must* come back. Then that each must do his share to hasten its coming by acting and buying in a way as near to normal as circumstances will permit. This will be real economy in the end.

SHOP EQUIPMENT NEWS

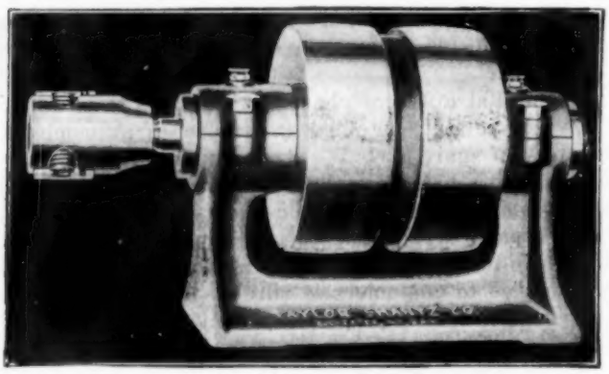
SHOP EQUIPMENT • NEWS •
A weekly review of modern designs and equipment

Descriptions of shop equipment in this section constitute editorial service for which there is no charge. To be eligible for presentation, the article must not have been on the market more than six months and must not have been advertised in this or any previous issue. Owing to the news character of these descriptions it will be impossible to submit them to the manufacturer for approval.

• CONDENSED • CLIPPING INDEX
A continuous record of modern designs and equipment

Taylor-Shantz Bench Tapping Machine

The illustration shows a horizontal-spindle, bench tapping machine placed on the market by the Taylor-Shantz Co., 478-86 St. Paul St., Rochester, N. Y. The machine has a capacity up to ⅜-in. taps. When the work is pressed against the tap, the spindle turns in the direction necessary to cut the thread; but when it is pulled away, the direction of rotation is reversed, so as



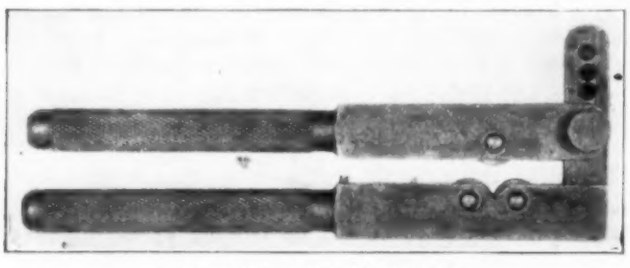
TAYLOR-SHANTZ BENCH TAPPING MACHINE
Specifications: Maximum capacity of chuck, 21/64 in. Pulleys, 5 x 1¾ in. Length of spindle and chuck, 12¾ in. Size of base, 7½ in. x 5 in. Total height, 6½ in. Weight, 21 lb.

to withdraw the tap. The reversal is accomplished by means of a leather-faced friction disk between the pulleys. The cushioning action of the disk is said to minimize the danger of tap breakage.

The machine can be driven directly from the lineshaft by an open and a crossed belt, no countershaft being necessary. It is equipped with a Jacob's chuck.

A. D. Hand-Knurling Tool

The illustration shows the hand-knurling tool recently placed on the market by the A. D. Knurling Tool Co., 120 E. 128th St., New York City. The tool is made in three sizes. The No. 2 size handles work from ⅛ to 1¼ in. in diameter. It is ½ x 2½ x 6½ in. in size and weighs about one pound.



A. D. HAND-KNURLING TOOL

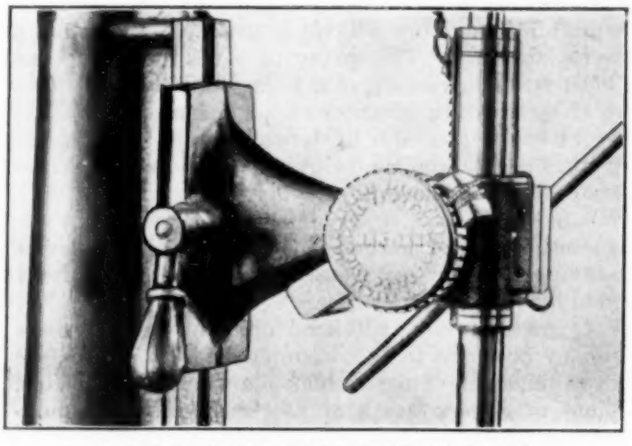
The tool is intended to be held in the hand, the work being rotated between centers or in a chuck. It can be used on work held in a drilling machine spindle, or turned by hand about work held in a vise, in the same manner as a die would be turned about it for cutting threads.

The work is held between three knurls, the distance between the jaws carrying them being adjustable. Usually the knurls are held against the rod or tube being knurled by gripping the two handles. It is stated that non-circular work, as elliptical, hexagon or even square stock, can be knurled in this way. However, a bolt can be inserted, so as to hold the jaws in position. In case that it is desired to keep the tool properly set when doing work that is rough or has a variable diameter, pieces of spring wire about 7 in. long can be inserted in the ends of the handles and fastened together by means of a ring, thus providing a spring clamping device.

Martian Drill Protector

The F-S Machine Specialties, Inc., 171 Washington St., Newark, N. J., has recently placed on the market the Martian drill protector shown attached to the head of a drilling machine in the accompanying illustration. It is intended for use on sensitive drilling machines when using drills ½ in. in diameter or smaller. It is stated that the device prevents the breakage of small drills when they pass through the under side of the work, because it keeps the rate of feed the same as when cutting through the solid metal.

The device must be set for the depth of hole to be

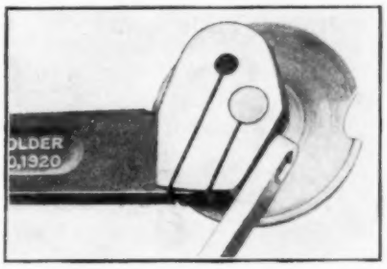


MARTIAN DRILL PROTECTOR IN PLACE

drilled. When the drill breaks through, the operator continues to feed as before until a positive stop is reached, the drill then being through the work. The action of the protector prevents the drill from advancing too rapidly, thus keeping it from seizing. When drilling holes to depth, the device will provide a positive stop, being set by means of the worm.

Smith Cutting-Off Tool

The R. G. Smith Tool and Manufacturing Co., 315 Market St., Newark, N. J., has placed on the market the cutting-off tool shown in the illustration. The tool is intended for use with the spring toolholder made by the same company and described in the *American Machinist* on page 694, Vol. 53. It is circular in form, being held by a shank on one side of the center. The thickness of the cutting edge gradually decreases around the circumference. To sharpen the tool, it is necessary to grind only the top of the cutting edge, the proper clearance being thus maintained. It is said that the available cutting edge occupies over 300 deg. of the circumference of the tool. The tool is said to be particularly adapted to use on automatic screw machines and turret lathes.

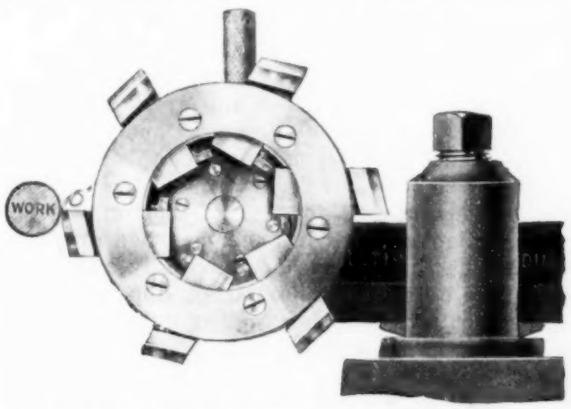


SMITH CUTTING-OFF TOOL

Cruban "Multiplex" Threading Tool

The illustration shows the "multiplex" threading tool recently brought out by the Cruban Machine and Steel Corporation, 63 Duane St., New York, N. Y. It is intended for the quantity production of externally threaded parts. Six cutters or knives are carried in a ring or turret capable of rotation about a horizontal shaft held in a bearing at the end of the shank. The shank can be mounted in the toolpost of a lathe or on a block on the cross-slide. The cutters are ordinarily set for depth only once for a job or for a number of parts. One complete revolution of the turret should be sufficient to cut any thread up to No. 12 pitch without disturbing the position of the cross-slide, a point claimed to increase the speed of production.

The cutters should be set so that each cuts slightly deeper than the preceding one, the last finishing the thread. When starting the cut, the first tool is in the cutting position, as shown. At the end of the cut the pin or handle on the top of the bearing is pulled by hand, thus disengaging the tool from the work. The feed is then reversed to bring the tools to the starting point. To start the next cut, the operator again pulls the handle, thus putting the next tool in the cutting position. This action is continued until the thread is finished. It is claimed that manipulation of the cross-slide is eliminated and the possibility of gouging of the tool diminished.



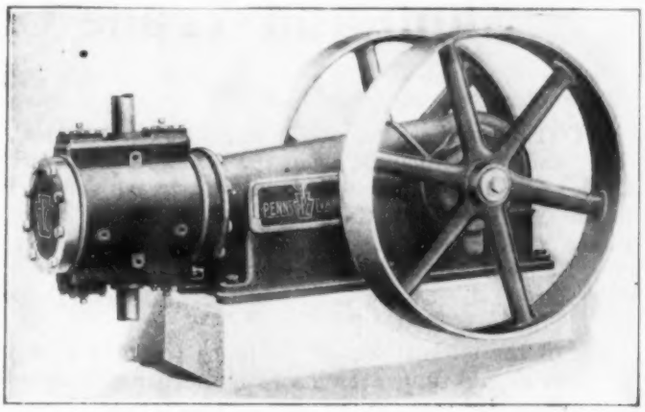
CRUBAN "MULTIPLEX" THREADING TOOL

Each cutter is provided with a micrometer adjustment for depth of cut, and is held in position by locking screws. They can be removed for grinding. Either chasers or cutters of high-speed or of carbon steel can be furnished. The shank is $\frac{5}{8}$ x $1\frac{3}{8}$ x $4\frac{3}{4}$ in. in size and can be furnished either straight or with a left-hand offset.

Pennsylvania Air Compressors and Vacuum Pumps

The Pennsylvania Pump and Compressor Co., Easton, Pa., has placed on the market air compressors and vacuum pumps of similar construction, the illustration showing an air compressor. The vacuum pumps have, of course, greater cylinder diameters than the air compressors for the same length of stroke. The positions of the valves are also reversed, the discharge being at the top of the compressor and at the bottom of the pump.

The mechanism is completely inclosed, so as to exclude dirt, and splash lubrication is used for the driving parts. It is claimed that the oil does not work into the air cylinder, although only one stuffing box is used, because of a baffle plate and because the crosshead, which has bored guides, nearly shuts off the oil chamber. A float gage indicates the level of the oil in the basin.

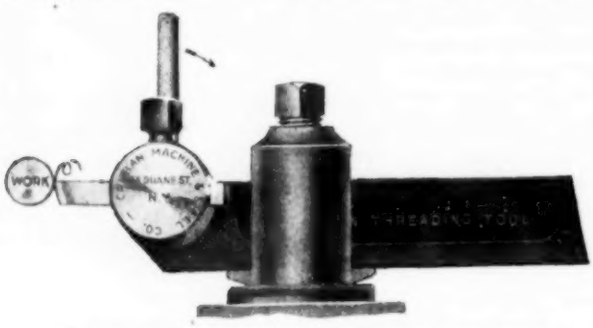


PENNSYLVANIA AIR COMPRESSOR

The crankshaft is forged steel and operates in removable bronze bearings. The box at each end of the connecting rod is solid, the eye at the crank end being slipped over the crank and the adjusting gibs and wedges then put in place. The flywheels are each made in one piece and mounted on the tapered ends of the crankshaft, being secured by keys and washers held by bolts. Ring plate valves are used; and they are so guided on the outside that it is stated that they cannot cock when in operation. The machine can be furnished integral with an engine for steam drive, a balanced piston valve being used for the steam engine.

Cruban "Rapid" Threading Tool

The Cruban Machine and Steel Corporation, 63 Duane St., New York, N. Y., has recently placed on the market a tool and toolholder, shown in the illustration, for external threading. The device consists of a shank held in the toolpost of a lathe in the usual manner and carrying a small cylinder, in one end of which is inserted the tool, while a small handle is carried on the other



CRUBAN "RAPID" EXTERNAL THREADING TOOL

end. The cylinder can be rotated slightly in the shank, so that the tool can be swung up out of the cutting position when desired.

When starting or cutting a thread the tool is in the position shown. At the end of the cut the tool is lifted about 45 deg. by pulling back on the handle. The feed is then reversed and the toolslide fed in by hand for the next cut while the carriage is traversing. In this way the machine can be kept running continuously and it is not necessary either to withdraw the toolslide before reversing the feed, or to disengage the feed nut. The tool can be provided with either straight or left-hand off-set shank. A wrench and a high-speed toolbit are furnished with the device. The tool is made in three sizes, taking toolbits $\frac{1}{4}$, $\frac{5}{16}$ and $\frac{3}{8}$ in. in size, respectively. The smallest holder is $\frac{3}{4}$ x $\frac{7}{8}$ x 5 in. in size, and the largest $\frac{5}{8}$ x $1\frac{3}{8}$ x 7 in.

Consolidated Three-Jaw Breast-Drill Chuck

The Consolidated Tool Works, Inc., 261 Broadway, New York, N. Y., has recently placed on the market a three-jaw chuck. It is intended for use with the breast drills made by the same concern, to replace the

CONSOLIDATED THREE-JAW BREAST-DRILL CHUCK

two-jaw chuck formerly used, being shown with the drill in the accompanying illustration. The chuck is made of steel. It has no springs and is said to be simple, strong and positive in action.

Shop and Trade Conditions in Europe

BY E. A. DIXIE

A LOT of bunk has recently been printed in American and foreign papers about the resumption of work and return to pre-war conditions in the shops of Belgium, England and Germany. I have just returned from a European trip and beside my own observations offer the combined testimony of a number of engineers with whom I talked and who had been in many shops which I did not visit.

One of the stipulations of the peace treaty was that Germany should return the machine tools which she had looted from the shops of the various Allies. The manner in which this has been carried out in a number of shops in Belgium affords a notable example of the much-advertised German efficiency. As I remember it this stipulation required that the Germans return similar tools but did not specify that they should return exactly the same ones. In several shops in Antwerp and in numbers of others throughout Belgium the Germans returned the identical tools which they took away. Some of them, I was told, had evidently been used during their stay in Germany, but so far as inquiry could elicit they had been kept in good running order.

Loss of Belgian Skilled Mechanics

However, the return of the tools was of little use. The thousands of skilled Belgian pre-war mechanics could not be returned. I am familiar with the Belgian mechanics of pre-war days; not only were they highly skilled but they were exceptionally industrious. Men of this type seem to have entirely disappeared and in their places are a discontented lot of near-bolsheviks who would rather talk than work.

In the ship-building centers of Germany things are in very bad shape, according to my informant, who is chief designer of machinery in one of the largest of our American shipyards. Practically all the ships the Germans build fall in one way or another into the hands of the Allies. This being the case the men have little interest in their work and consequently do just as little as they possibly can.

Labor Conditions in One German Shipyard

One visit was to a big yard in the north of Germany where ever since the signing of the treaty the men have alternately been finishing and setting on fire one of the largest ships which has so far been built. In this yard the work is carried on under the direction of a sort of soviet of 100 men selected by the workers. The managing director can not on any pretext go into the yard. He attempted to do so recently and was set upon and nearly killed by the men. He used this as an excuse for refusing to show my friend around the yard, as he dared not show himself for fear of causing a riot. He further told my friend that the men had even forced their way into his private office recently and that one of them had on that occasion struck him with a chair. He could not attend to his regular duties as chief of such a plant as all his time was taken up by endless argument and pow-wows with the heads of the yard soviet. The men, he said, seem to have gone crazy; no

sooner has he arrived at an agreement regarding some phase of their work with the heads of the soviet and they have gone into the yard to explain the details to the men than like as not a riot will break loose with perhaps the killing and maiming of several men. Half an hour after the dead and wounded have been removed the yard will perhaps be again normal.

The United States Blamed for Everything

In Germany, France, Belgium and England much of the blame for the adverse conditions is placed squarely on the shoulders of America. In Germany they say that President Wilson betrayed them. They assert that they were an unconquered people who laid down their arms on the strength of the promise of an honorable and just peace, that Wilson lied to them and that the American nation has cheated them. It is impossible to get them to see it differently; they still believe that they were set upon by England and her allies, and they just as firmly believe that they could and would have won the war if they had not listened to the siren song of Wilson's fourteen points.

Goods in Germany from the German viewpoint are very dear; from the American viewpoint with the exchange as it is they are very cheap. There are of course no large stocks of anything, but to give an example of relative pre- and post-war values the following will serve.

A certain small tool which before the war cost 15 marks a dozen, say $3.50, now sells for 60 marks a dozen. At the time when my informant bought these goods for export to South America the mark was worth just one cent. So while from the German viewpoint these goods cost four times as much (for one must remember that in Germany a mark is still nominally accepted a mark), from the American point of view they cost about one-sixth of what they did before the war.

Conditions in England Are Bad

In England things are in bad shape. With the connivance of the government the trade unions are riding the country to death. They have been coddled and given in to until their executives seem to believe that all they have to do is ask for more and still more. For this reason it is almost impossible to let a contract at a fixed price. In England all mechanics belong to unions; they can't get jobs unless they do. The unions have placed all sorts of restrictions on the activities of their members. Two examples will serve to illustrate.

A lathe hand had a certain piece to attach to the faceplate of his lathe. After taking the faceplate off the spindle and applying the piece to it, it occurred to him that by drilling two bolt holes in the faceplate the piece could be easily and securely attached. There was an idle drill press near but he had to wait till he could find a drill-press hand to drill the holes for him; his union rules prohibited him from drilling them himself.

The catch on my wife's handbag was out of order and I was referred to a nearby machine shop to have it repaired. Before reaching the shop I decided that a small sheet brass hook pivoted on one side and embracing both parts of the bag frame would make a satisfactory repair.

I explained to the foreman just what I wanted and made a sketch so that he would thoroughly understand. To my surprise he said he had no man who could do the job.

"It's a simple job of bending, drilling and filing; any one of those bench hands over there can do it easily," said I.

"I do not mean that they *cannot* do it but that they *will not;* they are not allowed by *their union* to do such a job," he replied.

"That's easily remedied," said I. "If you will hire me with the use of a vise and the tools I will do the job myself."

"I can't do that either," said he. "If I were to allow you to use a vise or tools the whole bunch would walk out." He handed me back the bag.

The "Shop Steward's" Job

In the shops they have a personality called a "shop steward," appointed by the men and recognized by the ministry of labor. His job is not, as one might suppose, the preparation of food for the men; it is, however, to a great extent the keeping of the bread out of the proprietor's mouth. In other words he is a sort of shop *in*efficiency man whose job seems to be to determine how little a man shall do and see that he doesn't do more.

A case in point:

The proprietor of a shop making automobile transmissions and differentials was so convinced he could make crankshafts at a profit that he ordered two high-priced crankshaft grinding machines from the United States. The guaranteed production of these machines was a crankshaft of a certain type every 30 minutes. The first crankshaft was got out in eight hours; likewise the second, and this was the time set by the shop steward, as I am given to understand. The proprietor of the shop then sent to the London agents of the grinding machine company, requesting them to send a demonstrator to instruct his men.

On his arrival the demonstrator went out into the shop to one of the machines and made some inquiries of the operator, who instead of replying asked him who in H—— he was. To which he responded that he was the demonstrator come to show him how to get out a crankshaft every 30 min., and took off his coat to make a start. As he did so the operator reached for his own coat and began putting it on. The foreman then came and asked the demonstrator to go to the office. Here the proprietor told him he better not bother about the demonstration as he did not wish to have the men go out on strike. The demonstrator stuck to his ground that he had come to see that his machine made good and suggested that he go away but return in the evening with the night shift, who would not know him. Arrangements were also made that half a dozen crankshafts were to be at the machine ready for him to grind.

He returned in the evening, finished the first shaft in less than the specified time and the whole six in an average time of 24 min. each. Just as he was taking the last shaft out of the machine one of the men came over and asked him if he didn't think he was turning out too much work.

The demonstration was, however, of no avail so far as increasing production and the proprietor was obliged to sell the machines as second hand.

Adverse Attitude of Older Mechanics to Union

One of the peculiar features of this union domination is the adverse attitude of the older and more skilled mechanics toward it. On the trains, on steamers and other places outside the shops and out of hearing of shop stewards and other union members I conversed with many union men. Without a single exception the

older men were opposed to the union policy of restricting output and standardizing wages, and over 75 per cent were in favor of some form of piecework, which is absolutely banned by the British trade unions. When asked why they did not legislate within the union in support of their views they all said that the unions were run by a large majority of young men who were always ready to listen to the mouthings of the labor agitators and that to even appear to disapprove of accepted union methods would likely cost them their jobs as the union members in the shops where they worked would make things so uncomfortable for them that they would be obliged to leave. The union would then see that they did not get other jobs until they changed their views.

Animosity Toward Unionism

Conditions such as these, which have even made many members of the unions dissatisfied with the way they are run, have naturally invited the antagonism of those outside the unions, against whom the union activities have been directed. This has resulted in strong anti-union feeling, which now permeates all classes in England.

The average Briton is somewhat slow to anger, but when thoroughly aroused it does not usually pay to rag him further. One of two things is sure to be the outcome of this strife: If the unions succeed the nation will be ridden to death and she will lose her foreign trade. If she loses that she is done. However, the other alternative is what is most likely to take place: England will eventually "get her mad up." When she does she will fall upon the unions and smite them. When she does this mechanics will be paid according to the quantity and quality of their work and not according to the strength of the union to which they belong; England will then regain her foreign trade and gradually re-establish her credit as the great manufacturing nation she has been.

Balancing Grinding Wheels

By W. Burr Bennett

The following is not intended to be a treatise on balancing but rather a few points that the writer has learned for himself about the balancing of grinding machines with especial reference to the common snagging grinding machine having a wheel mounted on each end of the arbor, and to disk-grinding machines of the same construction. As a starter the writer would suggest that you go to your stockroom and pick out a wheel, say 14 in. in diameter with a 2-in. face, mount it on an arbor and put it on the balancing ways; you will probably be surprised at the amount of unbalance.

Of course it is easy to calculate what trouble this condition of static unbalance will cause to the wheel when mounted on the spindle of the machine. First of all it represents an unbalanced mass revolving in a plane of its own and is going to make the grinding stand and the work vibrate badly even with a small amount of unbalance and a good heavy machine. This condition is shown in Fig. 1.

Now consider the case, where two wheels are mounted on the respective ends of the spindle, each one being out of balance on a static test, a condition as shown in Fig. 2. It is this condition that causes the worst trouble as the wheels and spindle try to move as shown in Fig. 3 with high resultant stresses, and even the heaviest grinding stand will vibrate.

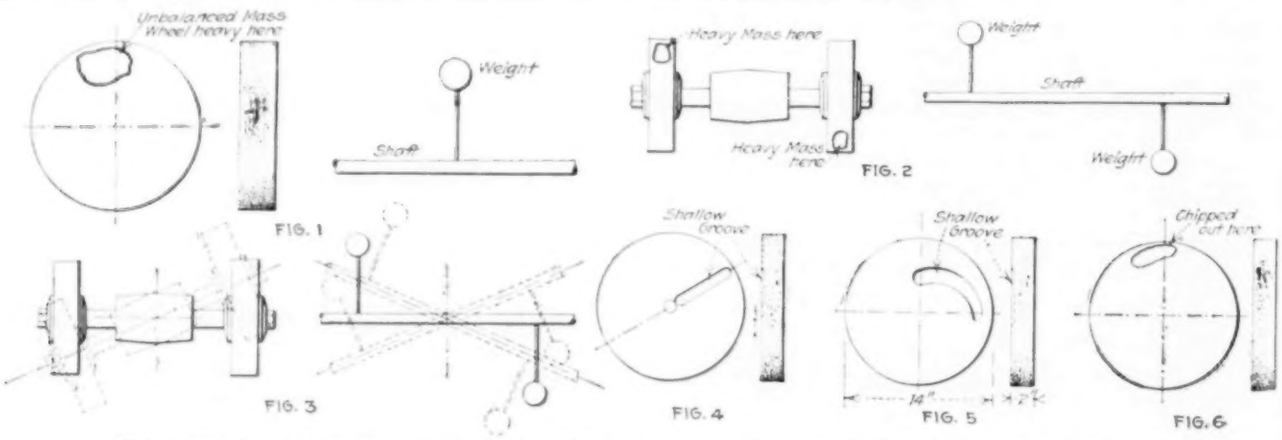
A Remedy

As this is a condition that the maker of the machines can hardly provide against, it is up to the shop man to correct his own trouble in this respect. Further, it could hardly be expected that the maker of the wheel could spend his time and money to get a very fine balance. It would perhaps be apt at this point to remind the reader that this condition of unbalance in the wheel is due to the varying density of the mass and is a condition typical of any structure of this sort.

To correct the trouble the writer took each wheel separately to the balancing stand and with a good hard diamond pointed chisel chipped away a little material from the side of the wheel in the form of a shallow groove running radially from the center of the wheel as per Fig. 4. However, in some cases it was not possible to chip a groove radially with the center of the wheel as the unbalanced mass seemed to lie in a spiral path, Fig. 5.

In other cases the heavy mass was localized and lay near the rim of the wheel, Fig. 6. This procedure takes a lot of time and can only be done by an experienced and reliable man. The cutting must be done with gentle blows to avoid fracturing the wheel, and no sharp corners must remain as a starting point for fractures.

The reader will perhaps question the effect as the wheel diameter is reduced by wear. This makes no appreciable difference if the chipped recesses are kept very shallow and actually executed at the unbalanced mass part of the wheel.



FIGS. 1 TO 6. SHOWING UNEQUAL DISTRIBUTION OF WEIGHT AND METHODS OF CORRECTION

Reminiscences of An Old-School Machinist

By R. Thomas Huntington

The apprentice boy in a locomotive shop in the early 60's could not well complain of a lack of variety in his work, though in after years and with a knowledge of modern machine shop equipment he might justly bemoan the fate that had decreed for him aching muscles and cramped and bruised fingers on jobs that the boys of a later day may contemplate in comparative comfort from the top of a high stool, while a machine is doing the work.

In a previous letter I have described some of the difficulties with which the early apprentice was obliged to contend in getting out work on a lathe; this time I will endeavor to tell you how he did planer work.

Surfacing Valve-Seats on a Locomotive

The valve seats on the cylinder of a locomotive built by the Norris Locomotive Works was a flat surface about 9 x 12 in., if I remember the dimensions correctly, and within its boundaries were three long, narrow, rectangular port openings. The surface had to be perfectly flat and smoothly finished; there must be no grooves, scratches, hollow spots, or other imperfections by which steam could find its way under the valve.

It would *now* be a very simple matter with the help of the cranemen to mount a pair of locomotive cylinders on the platen of a huge planer, line them up, and plane off both valve-seats at once, smooth and true; leaving but little, if any, work for the file and scrapers. *Then* there were few planers big enough for such a job and the work was generally brought to the scraper stage by a combination of hammer and chisel, brute strength, and skill.

The job would be started with a cape chisel by cutting a series of narrow grooves across the surface leaving about ¼ in. of metal between the grooves to be taken out with a flat chisel. There was nothing but the eye of the worker to guide him in this preliminary operation and it was essential to have the grooves all pretty nearly of the same depth; just deep enough to get under the scale of the casting and to avoid digging holes in the iron that would necessitate lowering the whole surface to match them.

Fitting the Ports to a Templet

After the scraping had been done to the satisfaction of the foreman the ports had to be filed out to fit a templet. These ports were three in number; a narrow one near either end and a wider one in the middle, reaching nearly across the seat. The edges had to be made perfectly straight and smooth, and so sharp as to cut paper. One of the difficulties of the chisel and file method of finishing the valve-seat was to avoid crumbling this edge, which must be carefully guarded against, for a slight nick or indentation would permit steam to pass through into cylinder or exhaust port at the wrong time.

When the ports had been properly fitted to the templet, the whole surface was lapped; using for the purpose a flat plate and a very limited quantity of fine emery.

Though the fitting of a valve-seat was a job for an expert mechanic, no fundamental truth was ever more clearly recognized in the early days than that the supply of skilled men for future service depended upon the faithfulness and care with which the boys were educated, and it was considered to be an important part of the foreman's duties to make experts out of the apprentices. To be sure, an apprentice-boy would not be expected to surface a valve-seat the first time he tried his hand at it; but after he had demonstrated his ability to produce flat surfaces upon other and less important work he would be given this work to do under the supervision of a journeyman, and if he were the right kind of a boy it would not be long before he was himself as capable as his instructor.

Speaking of chipping and filing flat surfaces brings to mind the remark of a "Pennsylvania Dutch" shopmate of mine, who, upon being requested by the foreman to take about an inch off the bottom of a certain pillow-block casting, said "Mine Gott! He dinks I am a blaner."

Making Cast-Iron Balls by Hand

Another example of skillful hand work was displayed in the making of the cast-iron ball check valves that were placed in the suction pipe from tender to boiler pump. There was one man who made all these balls, and he did it by taking first a cube of cast iron and filing off all the corners until he had a polyhedron with approximately equal facets. Again increasing the number of facets by taking off the remaining corners, being careful to keep all of the many sides as nearly equal as possible his piece gradually assumed the form of a ball; finally becoming so nearly round as to hold water in the valve when turned to any position. I never saw him do any work on these balls in a lathe.

This same man was considered the best screw-maker in the shop. He could catch the right pitch for any given number of threads per inch at the first trial and very seldom made a wabbly or "drunken" thread.

A Predecessor of "Armistice Day"

All hands were sitting around on benches and boxes eating their dinners one noon near the close of the Civil War when word was brought in of the fall of Richmond, Va. Whistles were blown and bells were rung all over the city. Orders soon came from the office, closing the works for the afternoon. Our big bell, the deep tones of which could be heard for more than a mile, joined in the clangor, and Mr. Norris conceived the idea of attaching the bell-rope to the crosshead of a nearby donkey-pump and letting it ring all the afternoon. This scheme worked fine; so fine indeed, that exasperated citizens in the neighborhood carried a complaint to the Provost Marshal, and that functionary sent an orderly to stop the noise.

At the close of the war, our shop had nearly completed an order from the Union Pacific Railroad for locomotives, and had under construction a batch of twenty-five for the U. S. Government to be used in war service; but as a large portion of our business had come from the South, and as prospects for future business from that quarter were not very bright it was not long after this that Mr. Norris decided to close the plant and sell the real estate and tools.

Some of the older employees were pensioned. I remember one man in particular who had been in the employ of the Norrises for over twenty-five years. This man had turned all the cylinder heads, both inside and out, for such parts were highly polished in those days. He had also turned the wristpins which were cast in place in the crosshead.

This job required the casting to be centered over the pin and the line of centers must be accurately square with the planed surfaces and with the tapered hole for the piston-rod. The crosshead would be mounted in the lathe, a hickory handle placed in the piston-rod socket, and the piece oscillated back and forth as far as the tool would allow.

The tool used has a peculiarly curved nose, something like a "gooseneck" tool, and that reached part way over the pin. It would, of course, finish but little more than half-way around the circumference of the pin, and, after one cut had been taken the crosshead must be reversed in the lathe so that the remaining surface could be reached. Several cuts were necessary to finish a pin and the job required a deal of skill and special knowledge to do well.

This man felt so badly about the closing that for a long time thereafter he would make trips almost daily to the now silent and deserted shop where he would stand before his old lathe and weep silent but bitter tears of regret. So far as I am aware he was the only man who had ever worked on this particular lathe.

Upon the closing of the shop Mr. Norris gave me a fine "recommendation" (which I still have, and highly prize) and thus ended my apprenticeship. Sometime I will tell you some of my later experiences.

A Pair of Old Pulleys

BY B. SHELL

In reference to the pair of old pulleys illustrated on page 1161, Vol. 53, of *American Machinist*, it occurred to me that the groove in the tight pulley was used to retain in position a brake block with which the machine could quickly be brought to a stop after the belt was shifted.

[An ingenious suggestion; but would not the groove have been located on the other side of the belt?—EDITOR.]

BY JAMES TATE

Mr. Bennett's article on page 1161, Vol. 53, of *American Machinist* as to the use of the V-groove on the tight pulley reminded me that I once saw the same idea used in an Ulster shop. A small round belt ran in the V-groove, which was deep enough and the belt small enough, so that the larger belt rode over it with no trouble. The small belt drove a little magneto, used to generate current for various testing purposes. This may not have been the purpose of the groove on the pulleys that came under Mr. Bennett's notice, but it seems, at least, as reasonable a solution as any.

BY J. A. RAUGHT

In reply to W. Burr Bennett on page 1161, Vol. 53, of *American Machinist*, I think I am making a safe guess in saying that the pulleys in question came from a cotton loom.

Some years ago I went through several cotton mills the machinery in which had been sold to a junk dealer, and upon each loom was a tight and loose pulley identical with those described by Mr. Bennett excepting that the spokes were "S" shaped. The V-groove on one edge of the tight pulley seemed to be quite common, though, as they showed no wear, I could not see for what purpose they were used.

Acme Threads in Motor-Jack Bushings

BY HENRY ARMSTRONG

Replying to Mr. Schwartz's inquiry on page 1082, Vol. 53, of *American Machinist* concerning clearances, tolerances, etc., which we used on Acme threads, I will state that the point I wished to bring out in my article on page 397 of the same volume was the saving effected by the changes made on length and clearance of taps. However, Mr. Schwartz brings up some interesting points in regard to tolerances, etc., and I think that I can furnish some further information, as requested.

The screws which we used to fit the Acme bushings were cut on a Landis threading machine and were fairly accurate when measured in accordance with the data published in the "American Machinist Handbook" except that the stock used was from 0.010 to 0.015 in. small, and as the threading operation threw up a burr, we used to grind this off on the side of a large disk grinding machine, the workman revolving the screw with his hands and finishing the operation very quickly and satisfactorily.

As the taps were made full size with a plus tolerance of 0.002 in. this gave us a clearance between the top of screw thread and bottom of tapped hole in bushing of from 0.005 to 0.010 in. which we found sufficient.

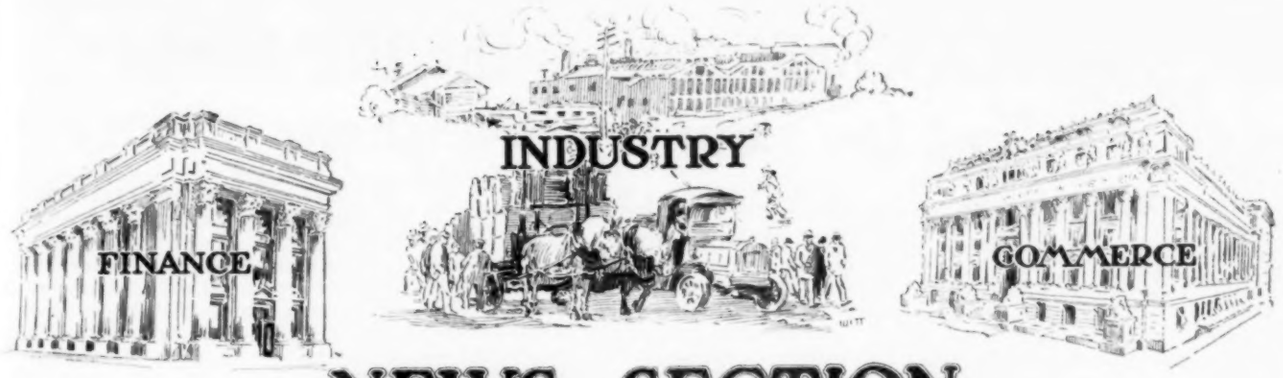
Regarding side clearance: we made the taps in accordance with the "American Machinist Handbook" on the width of thread measurement; that is about 0.163 in. at the widest part of the tooth. The first tap cut pretty close to this size and, of course, the screw would not fit as it was about the same width as the tap. However, the pressure exerted by the workman on the second tap made this tap cut more on the bottom side of thread as it went through the bushing. We cut some of the bushings in two and found that the thread space was from 0.010 to 0.015 in. wider than the width of thread on the tap, so that we had plenty of clearance on the sides.

The hole in bushing was made about 0.530 in. in diameter. This is larger than the U. S. Government standard but by making it this size we reduced tap breakage although we did not get a full depth of thread. However, when these bushings were put under severe test, invariably some other part of the jack broke before the bushing showed signs of weakness; proving that the depth of thread was enough for our purpose. I would not recommend that this practice be adopted for all purposes, as for some work a full thread is necessary for safety.

We made two screws, one slightly oversized and the other slightly undersized for measuring purposes. It should be understood that we were trying to get a large production at a small cost and could not afford the cost of great accuracy.

To sum up: we had from 0.005 to 0.010 in. clearance between the top of screw thread and the bottom of the bushing thread, and from 0.005 to 0.0075 in. on each side of the screw thread when the screw was in place in the bushing.

The dimensions and tolerances for the Acme thread should be decided by the A. S. M. E., as there is no reliable data to be found on this subject. The "American Machinist Handbook" gives dimensions of screws and taps but it will be found that the screw and nut made in accordance with this table will not fit, as the dimensions of the touching surfaces are the same.



NEWS SECTION

Activities of Engineering Council and Engineering Societies Service Bureau Transferred to American Engineering Council

Beginning Jan. 3, the transfer of the activities of Engineering Council and the Engineering Societies Service (Employment) Bureau has been made to American Engineering Council.

The American Engineering Council now has an office in Washington at the McLachlen Building, 10th and G Sts., with A. C. Oliphant as acting assistant secretary in charge. This office is available for the member societies of the Engineering Council.

The Engineering Societies Service Bureau is being maintained in the Engineering Societies Building, 29 West 39th St., New York City, with Walter V. Brown in charge.

Pending the development of a more permanent organization which may direct this very important activity of the American Engineering Council and which has had such a close relationship with the secretarial responsibilities of the member societies of the Federated American Engineering Societies, the secretaries of the American Institute of Mining and Metallurgical Engineers and the American Society of Mechanical Engineers and the American Institute of Electrical Engineers have been requested to act as a Committee on Management to conduct the service bureau until such time as a permanent organization under the American Engineering Council can be effected.

The Committee on Procedure of the Executive Board of the American Engineering Council, voting to take over the employment service, specified that the applicants should be arranged in two groups; first, those who are members of member societies of the Federated American Engineering Societies, and, second, all others.

As a means of communicating with the secretaries of the member societies of the Federated American Engineering Societies, a bulletin listing positions open will be issued regularly. The first of these bulletins will be sent very shortly.

The following committees of former Engineering Council have been invited to act as committees of the American Engineering Council:

Classification and Compensation of Engineers; Co-operation with American Institute of Architects; National Board for Jurisdictional Awards in Building Industry; National Service Department; New York State Government Reorganization; Patents Committee; Payment for Estimating; Russian-American Committee; Types of Government Contracts.

Smoot-Reavis Resolution Passes

The Smoot-Reavis resolution providing for a survey of the executive departments of the Federal government has become a law without the signature of the President. A joint congressional committee will be organized under the bill. It is expected that Senator Smoot, of Utah, will head the committee. The bill provides for the employment of a representative of the committee to take charge of the immediate direction of the survey which is to be made.

Problems Facing U. S. Exporter

"American manufacturers and producers enter the new year facing a serious situation in export trade," says W. L. Saunders, chairman of the board, Ingersoll-Rand Co., in the *New York Commercial*. "This is made more serious by the fact that certain fundamental things which govern foreign trade between countries are not understood or are looked upon as matters of opinion rather than matters of fact, as for instance:

(1) Under present conditions the only way to rectify permanently the great difference in exchange between certain European countries and the United States is to either sell Europe less or buy more from Europe. It is out of the question to talk about payment in gold, because there is not gold enough in the world for this purpose. If I want to buy your hat and you sell it to me for $5, I must either give you gold or a gold note worth $5, or I must give you $5 worth of work or I must give you a pair of shoes worth $5. Failing in any one of these you may tide the situation over for a certain length of time by giving me credit. Now, Europe has not gold or gold notes to give us. They cannot liquidate their huge debts in services. If we give them credit it only puts off the final payment, so that the one and only thing left is goods. In this matter there is no difference between two individuals and two corporations, governments or individuals in foreign countries. The principles are the same.

(2) The reason why there is such a wide difference in exchange is that Europe is on a paper, not a gold, basis. This situation is hopeless, so far as any attempt might be made to rectify it within a reasonable term of years.

(3) Because of the depressed conditions in Europe, and the large issue of paper money, living conditions, prices of commodities and of labor are lower there than they were before the war. The inevitable result of this is the production of goods over there can be made at lower costs than in the United States—so much lower in fact that America's export trade is threatened as it never was before. There are many things now made in America the cost of which is greater than the selling price of the same thing made in certain countries of Europe. This situation is not growing better, but worse. The immediate remedy may be an extension of credits, but the cure can only be effected by either buying more from Europe, which means also selling less, or, which is still better, establishing American works in Europe, making there the same things we make here and in this way holding our trade with foreign countries through a proportion of our capital invested there instead of at home."

P. & H. Employees Hold Annual Xmas Party

The fourth annual Christmas party of the employees of Pawling & Harnischfeger Co., crane and hoist builders, Milwaukee, was held on Dec. 21, at Riverview Roller Rink. Because of the fact that the majority of the 1,100 employees have been connected with P. & H. for long periods of service, ranging from 10 to 20 years, this was an unusually happy Yuletide affair.

Business Conditions as the Big Banks of the Country See Them

National Bank of the Republic, of Chicago, Sees Early Recovery of Business

Despite the great amount of pessimism which one hears today, it is doubtful if most people realize the extent of the deflation through which business has passed during the past twelve months. Deflation in this instance has been essentially one of commodity markets, although naturally preceded and accompanied by a liquidation of the stock markets in the process of discounting the reduced earning power of corporations generally. The familiar symptoms of industrial curtailment, unemployment, almost complete lack of forward buying on the part of retailers and wholesalers, slow collections and the failure of inexperienced, undercapitalized and grossly over-extended concerns have all been present. But the spectacle of large failures, of temporarily embarrassed concerns forced to the wall, of the widespread withdrawal of deposits by the timid from the banks of the country has not, and undoubtedly will not, be witnessed in this instance, thanks to the massing of the financial resources of the country back of the elastic Federal Reserve System.

Little Drop in Commodities Where Labor Cost Is High

While certain articles of commerce have receded very little, others have dropped to a point very close to their level in January, 1915 as for instance hides, rubber, coarse grades of wool, coffee, copper, spelter, tin and antimony, several of which, incidentally, are now even lower than before the war. The significant fact is that raw materials have suffered relatively the greatest amount of depreciation. An even closer inspection warrants the statement that the resistance to declines in the case of any commodity or manufactured article has been in direct relation to the amount of labor represented in its finished state. The conclusion is inescapable that price inflation has come about largely through the immediate agency of inflated labor costs. This fact in itself militates against any expectation that prices will all descend to the pre-war level, or that those already there will remain.

Most Employers Against Wage Reductions

It might be said parenthetically that while grossly inefficient workmen, or so-called skilled workers who owe their employment in that capacity to the erstwhile labor shortage, and who are skilled in only one mechanical process, will undoubtedly be replaced gradually, employers of labor generally are opposed to wage reductions except where they are temporarily an alternative to a complete shut-down, or where the lowered cost of living warrants such reductions. The manual workers of the country have in the past four years gained a standard of living which it is for the best interests of the country to perpetuate. This of course implies real wages, or command over goods, as opposed to money wages. Although the latter may decline, a contemporary and parallel decline in the cost of living will maintain those real wages. It should not be overlooked, also, that there is a large class of people in the country, dependent upon salaries which have advanced comparatively little during the war, whose purchasing power is increasing with the general decline in prices.

Replenishment of Supplies Necessary Soon

While it may be said that the worst of the business decline has probably been seen, it is probable also that some time must elapse before commodities again become adjusted in their true relation to one another. But experience has shown that any voluntary and prolonged curtailment in the output of essential goods has produced scarcity and high prices eventually, since the public continues to consume. Just how much of a supply of goods is in the hands of the consumer, due to the extravagance engendered by wage levels which in very many cases had advanced far more rapidly than essential living costs, is a matter for conjecture. But replenishment, sooner or later, will become imperative. While curtailment of industrial output will exist while there is still a surplus of high-priced goods unliquidated, there are other branches of activity which may well demand attention.

Failure of the Much-Advertised Building Boom

The much-advertised building boom came to little because of the restrictive influence of tight money and the lively expectation of lower building costs. While there is possibly an oversupply of commercial office space and industrial building for the time being, housing is still greatly in arrears. Finally, the railroads, which have been much neglected during past years, demand increased facilities. It is significant that although the roads have increased the average loading of cars and have speeded up their movement, congestion has only disappeared with the curtailment of industrial operations. The country paid a great price for insufficient transportation facilities during the war—how great a price will only be known when the history of that conflict is written.

Italian Discount and Trust Co. Tells of Industrial Disturbances in Italy

The industrial disturbance in the metallurgical trades of Italy has been brought to a close. Work has been resumed everywhere. It is now possible to present a true picture of the entire situation, which was brought about by a small minority of noisy and extreme radicals. The great mass of Italian workers—right-thinking, hard-working, substantial citizens—kept their heads and refused to be led astray by leaders who did not have the real interests of the workers at heart.

Causes of Trouble

The causes leading up to the trouble may be plainly stated, thus:

The workers in the metal industries demanded more wages, claiming that what they received was not sufficient to meet their living expenses. The manufacturers refused to accede to these demands, on the ground that the condition of the industry did not yield profits sufficient to pay higher wages at that time—it being pointed out to the workers, also, that constant jumps in wages did not bring any relief into the situation in that these wage increases tended only to make commodity costs mount still higher. The workers considered this reply calmly, folded their arms, and refused to work. Realizing the impossibility of going on without workers, the manufacturers closed their plants. The men refused to leave, thus becoming the masters in practically all of the engineering establishments in Italy.

The workers then demanded the right of a certain voice in the management and a participation in the profits, maintaining that industrial peace could be secured only by their possessing a guarantee that they were not being exploited for the benefit of capital, they agreeing at the same time to bring about an increase in production.

Workers' "Control" in Management

At this point the Italian government stepped in and passed a law whereby the workers were allowed a certain "control" in the management of the factories and a participation in the profits—the basic motive of this action being that if the workers were given the opportunity of collaborating with the management in the internal affairs of the factories, they would come to know that there is a limit beyond which it is not safe to go without jeopardizing the entire industrial structure, and

that this joining of capital and labor would tend to operate beneficially on economic conditions and the national well-being.

The new law is now in force. And it is hoped, and believed, that a satisfactory and lasting peace will thereby be obtained, together with increased production and greater general prosperity.

Peoples National Bank of Pittsburgh Discusses Influence of Foreign Trade on Our Domestic Situation

Developments in our foreign trade will have much to do with the domestic situation. Among serious-minded people there is a feeling that in this year 1921 the commercial nations of the world will enter a new era, and more courageously face the problems of the future. During the past two years affairs have drifted. The inevitable reaction from war to peace affected statesmen responsible for the conduct of nations as well as individuals. New standards of international relations were suggested and experimented with; old standards of individual initiative and self-reliance temporarily fell into disuse.

This was not an unnatural development of four years of self-abnegation on the part of the individual; of a surrender of his long-cherished personal rights, in his home as well as in his counting-room; of a merger of national interests into international—at least among the Allies—and of general submission, almost without questioning, to newly-created authorities, to whom the new conditions were as alien as they were to those who submitted. The only thing which did not change during and after the war was human nature. This is now reasserting itself as the world enters the secondary stage of reaction. It has been strikingly manifested in the Geneva meetings of the Assembly of the League of Nations, in the gradual annulment of war-time rules and regulations affecting business in the United States, and in individuals who have been held in restraint thereby during the past four years.

Policy To Be Adopted in Relation to Credit Advances Important

A matter of vital importance in its bearing upon the future of the United States will be the policy adopted in relation to credit advances for the development of our external trade. Shall the major exports of capital represented by goods and additional credit advances be to the most favored commercial nations (which are at present our largest debtors), or to backward nations whose exploitation—using the word in its best sense—promises richer returns in the more or less distant future?

It was once declared by a certain great captain of industry who fell into grave difficulties: "My creditors cannot afford to let me fail; I owe them too much!" That in a nutshell is the position of the United States toward our national debtors, and of Great Britain toward her national debtors. The problem of the future will be the "nursing" of these debtors, and this alternative is likely to present itself: to supplement our credits to Europe with additional advances, thereby enabling the nationals which have long experience and training in dealing with countries less advanced commercially to recoup themselves, or for ourselves to compete strenuously with our European debtor nations in the development of the markets of the backward countries of the Orient, Asia, Africa and South America.

The popular theory is that we must strain every effort to retain our fortuitous gains made while England, France, Germany, Italy, and Belgium were at grips for five years, and add thereto. Furthermore, that we must expand our merchant marine, carrying our imports as well as our exports in our own vessels acquired at such extravagant cost during the war and since the armistice.

An Unpopular Theory

It is at least permissible to consider what for the moment may be an unpopular theory, namely: to cultivate what is best within our own national boundaries and the boundaries of our contiguous neighbors, and leave to old hands at the business the long-practiced job of cultivating the backward countries, and to assist these "journeymen" in such work (who are at the same time so greatly in debt to us) by making them further advances of credits.

The people of the United States are the largest per capita consumers in the world today and they have not reached the limit in this respect. In the prime essentials (the production of foodsuffs and of the materials which enter into the provision of shelter) we still have a surplus. To a considerable extent the so-called backward countries which before the war were being supplied with capital for their development by the leading European nations contain the potentialities for excess food production which is imperatively needed by their financial creditors.

As the world gradually recovers ground lost during the war, the task of England, France and Germany in regaining their lost trade in commercially backward countries will become easier physically and financially, than the task of the United States in competing with them in these pre-war markets. World trade consists in an exchange of things, not, as too many persons seem to think, in an exchange of goods by one nation for the gold and silver of another. The nations whose economic necessities, financial as well as commercial, are greatest will make the largest sacrifices in order to retrieve and maintain outside markets.

Europe Doubling Her Sales to the U. S., Especially in Manufactures and Manufacturing Material

What are the articles with which Europe has doubled her exports to the United States? Our trade figures, says a statement by The National City Bank of New York, show for the ten months for which records are now available just twice as much in value of merchandise imported from Europe as in the corresponding months of 1919 and four times as much as in the same months of 1918. The value of merchandise imported from Europe in the ten months ending with October was $1,078,000,000 against $543,000,000 in the same months of 1919 and $272,000,000 in the same months of 1918. Our chief imports from Europe, prior to the war, were manufactures and especially luxuries and certain manufacturing materials which the European countries had brought from their colonies to their own ports before re-shipping them to the United States. During the war, however, the colonies found it more convenient to ship their merchandise direct to the U. S. and as to the manufactures which we were accustomed to draw from Europe, it was scarcely expected that her factories would be able to so quickly resume the outturn of any considerable surplus.

In both of these lines, however, the return to pre-war conditions has been rapid. Most of our manufactures imported are drawn from Europe, and manufactures show in the imports for the ten months ending with October, 1920, a total of $1,460,000,000 over $844,000,000 in the same months of last year, while manufacturing material shows in the ten months of 1920 $1,600,000,000 against $1,324,000,000 in the same months of 1919.

In raw manufacturing material, Europe is rapidly returning to her pre-war custom of accumulating the products of her colonies at her own ports before sending them to the United States. Of Egyptian cotton, Great Britain has this year sent us $10,000,000 worth against $5,000,000 in the corresponding months of last year; of india rubber, $34,000,000 worth against $16,000,000 in the same months of 1919, and only $4,000,000 in the corresponding months of 1918, while Netherlands has sent us nearly $4,000,000 of rubber from her East Indian colonies as against a quarter of a million one year ago and nothing two years ago. Of pig tin, Great Britain has sent us $13,000,000 worth as against $8,000,000 in the same months of the preceding year.

Exports of Automobiles in 1920 Far Exceed All Records

Exports of passenger automobiles from the United States for the year 1920 far surpass all records, says the National Bank of Commerce in New York, in the January number of its magazine, *Commerce Monthly*. In the first ten months 112,376 were sent abroad as compared with 67,145 in 1919,

the highest previous year, and 28,306 in the fiscal year ending June 30, 1914, the highest prewar year.

"Shipments to all parts of the world showed remarkable gains, the numbers sent to the United Kingdom and British India being especially noteworthy," it is pointed out. "These sales have not only benefited American industry but the widespread use of these cars will also facilitate the development of further trade in American automobiles, accessories and parts."

The largest exports were to the following countries: United Kingdom, 18,154 cars; British India, 10,848; Canada, 7,369; British South Africa, 5,510; Cuba, 5,286; New Zealand, 5,099; Brazil, 4,968; Sweden, 4,887; Dutch East Indies, 3,439; Argentina, 3,372; Uruguay, 3,287; Norway, 3,000.

U. S. Trade With Spain Grows

American exports to Spain increased 240 per cent from 1914 to 1919, from $30,000,000 in 1914 to $102,000,000 in 1919. The displacement of Germany, and also, in some part, of England and France, in the Spanish market largely explains this great favorable American trade growth, according to Trade Commissioner Arthur Young, in a report entitled "Spanish Finance and Trade," just published by the Bureau of Foreign and Domestic Commerce of the Department of Commerce.

"Spain, like the United States, changed from a debtor to a creditor nation as a result of the war," the report says. "The geographical position of the country and its great natural wealth made possible the supplying of the war needs of the belligerents on an important scale. The total trade balance in favor of Spain from the beginning of the war to the close of 1919, was approximately 4,000,000,000 pesetas ($772,000,000 at nominal par of exchange). This strengthened the financial situation in the country in a remarkable manner. It is a striking fact that Spain granted a credit to the United States of 250,000,000 pesetas, of which 155,000,000 were actually utilized.

"The meagerness of economic information about Spain available to American interests has not been in keeping with the growing importance of that country," states the Bureau of Foreign and Domestic Commerce in calling attention to the report which it says was prepared to fill the existing gap in its information service. The report describes the principal features of the financial system of Spain, with special reference to the effects of the war upon the economic activities of the country. Particular attention is given to the growth of more direct financial and commercial relations with the United States. The policies adopted by the principal European countries in their trade with Spain with respect to the establishment of branch banks, the granting of credit, the promoting of sales, and the investment of capital are likewise discussed. The report is known as Special Agents Series No. 202, "Spanish Finance and Trade."

Business Conditions in England

Conditions in Machine-Tool Market Are Generally Bad—Textile Machine and Locomotive Industries Good—Situation of Great Britain—Unemployment Insurance

By Our London Correspondent

London, Dec. 23, 1920.

The industrial and economic storm has undoubtedly commenced but despite the rumblings and more definite warnings of trouble that have for some months been recorded in these columns, a large section of the community has found itself unprepared for trouble. Whatever the direction in which one looks it is difficult to see light breaking through. Still it must be recorded with satisfaction that the electrical power-station engineer strike has again been postponed and that the strike half promised in the engineering industry will not take place yet awhile, for the claim for an advance of 6d. an hour for time workers and equivalent increases for day workers has been dropped for a period of six months. This postponement followed many conferences between representatives of employers and employees.

Meanwhile a joint committee may consider "the adjustment of wages on the basis of fluctuations in trade," though in the past this basis has usually been rejected by the unions concerned. The claim for an advance was made on the ground of increased cost of living. This is admitted. It is some seven or eight months since any increase in engineering wages rates was effected and in the interval the cost of living, however estimated, has certainly gone up considerably. Now, for the first time for many months, the cost of living, based on average retail prices of all commodities taken into account, is reported by the ministry of labor to show a decline, being 169 per cent over that of July, 1914, against 176 per cent last month. The decline may be described as due to reduction in the price of sugar and clothing. It is wholesale, not retail, prices that have been steadily or sharply reduced. But with the lapse of time some amelioration of the retail position may be expected.

Raw Material Prices

Prices of raw materials for engineering products have been falling, but the effect is not particularly marked on the cost of the finished machine. Firms are now able to quote definite prices and, subject to the usual strike clauses, delivery dates.

The machine-tool industry is not of course in the position of the motor industry in that, so far as the writer is aware, no firms have had to close down completely. The present state of the motor trade, now notorious, ought to provide a warning to those journalists who, presumably under suggestion, asserted a few weeks ago that the industry was at least in a relatively strong position. It is foolish to bluff when the facts are clearly known.

As to machine tools, observation on recent journeys indicates that while conditions steadily become more difficult in Yorkshire, and indeed everywhere, Manchester is in a better position than Birmingham, Coventry and also London, where the engineering industry, as a whole, is in large part a war product; a number of small firms having arisen who, after war demands had been satisfied, devoted themselves in minor ways to the motor trade and are suffering the same troubles. In machine tools, while drilling machines have been in some demand, the market for milling machines and turret lathes, to take only two types of tools, has faded.

One well-known Lancashire firm, though still very well occupied has not received an order of note for the last three months. While half-time working is not uncommon one old-established firm, for the first time in its existence, has but two working days to the week.

Small Tools

The small-tool side of the business can hardly claim to be in a better position. At a recent auction in London some 1,100 end mills went for £28. The twist-drill trade, like the milling-cutter trade, is largely concerned in price-maintenance associations. Branded twist drills have been thrown on the market by auction and bought by dealers at prices which readily enable them to undersell the original makers.

Textile Machine Industry

As we have stated previously, the textile-machinery industry in Lancashire still find good employment by reason of orders from abroad; in fact, not very long ago deliveries promised on inquiry were stated in years. The locomotive side of engineering is also satisfactorily engaged, although in one center there is some measure of unemployment, due apparently to shortage of skilled iron foundry workers. Indeed, according to the last available figures—a considerable rise has occurred since their issue—for the Lancashire and Cheshire district in engineering nearly 7,000 names, including laborers, were on the register as unemployed; while 588 vacancies had been notified, 547 of them being in connection with molding.

Motor Industry

Turning again to the motor industry, it is reported that a Manchester firm has suspended 1,100 workers for a month, and that a Southport firm has shut down for a fortnight. One large factory farther south has shut down indefinitely. Nevertheless, the condition of engineering generally seems to be better than that of the cotton or wool industry and, regarding the Yorkshire trade, the anomoly was recently

noted of production at the rate of 40 per cent of normal being accompanied by an increase on wage rates of 20 per cent.

Situation Gloomy

When will the storm reach its height or rather when will any sunshine be visible is naturally the question on which opinions are offered. A fortnight ago the turn of the year was often suggested; now that opinion is held by no more people than those who hold the view that the crisis will last four or five years—for such an opinion has been expressed. Next April or so has at the moment the largest number of votes, apparently on the principle that "in the spring the young men's fancy lightly turns to thoughts of—say machine tools." At the moment it is probable that another six months will be required to get us through the worst. The government, accused of waste in expenditure, is replying by permitting the continuance of the half-timer and ordering local education authorities not to incur new expenditures. But the day-education continuation act will undoubtedly be brought into operation in London, where the education officials have high ambitions and apparently need not trouble about cost.

Unemployment Insurance Act

Great Britain has just brought into operation an unemployment insurance act which gives the unemployed 15s. a week. To meet the crisis—a mean estimate gives three-quarters of a million persons unemployed — the qualifying period is to be suspended temporarily. Then, apart from the £6,000,000 to be spent on arterial roads, a committee will have the disposal of £3,000,000, out of which grants can be made toward the cost of labor on local schemes—except roads and housing—for the relief of unemployment, this fund being available up to the extent of 30 per cent of the labor cost mentioned.

Getting Ex-Service Men Into Unions

Again, the building trades, which are notoriously some 65,000 workers down in numbers as compared with the pre-war period and which have at the lowest estimate 10 years full work ahead, are to be bribed to accept 50,000 ex-service men through the trade unions concerned within the next three years, £5 a head being paid for their training, with other guarantees to be given regarding time lost owing to bad weather. Thus half-wage rates will be paid for the first 22 hours lost in a week, and three-quarter rates for any time lost in excess of 22 hours, while if a whole week is lost owing to the weather conditions the man will be paid as if he had worked 27½ hours. In addition, this particular industry is to provide a supplementary scheme of unemployment insurance to increase the unemployment benefit, the training grants being, it is suggested, a nucleus for such a fund. The trade unions generally, it should be explained may work the unemployment-insurance scheme, provided that from their own funds they add one-third the benefit.

No one regards the proposals as affording a remedy for unemployment—the nightmare of the British working man—and it has been left to Lloyd George, the prime minister, to suggest emigration to the colonies. So much for "the land fit for heroes."

Breakdown in Industry Worldwide

The breakdown in industry seems to be worldwide. In Great Britain at any rate the mental attitude of the worker now is very different as compared with the pre-war period. In many cases the man has risked his life for the state and looks definitely to the state to insure his existence. And the attitude of the authorities to the hitherto illegal street collections and the seizure of London and suburban public baths and libraries is significant. The London unemployed are, in fact, organized.

Nobody can deny the terrible conditions which prevail in central and eastern Europe. The danger exists that these conditions may spread westward. New markets must be sought and the strongest pressure has been put on the government to arrange for the reopening of trade with Russia. The same must apply to Germany; otherwise the exchanges cannot be re-established. There is much sentiment—and not a little personal interest—that naturally opposes dealing with the German; it will have to give way to facts.

The Trend Toward Combination in the German Industries—A Critical Study of the Stinnes' Policy

By C. A. Heise

While the political parties and the government are still at loggerheads as to the best method of procedure for the socialization of the German mines and collieries, fundamental changes are taking place in the mining and manufacturing industries. Never before in the history of modern industrial Germany has there been such a marked tendency for financial transactions on a large scale, company fusions, mergers, and formation of combines as at the present time.

This remarkable activity is all the more noteworthy since it manifests itself at a time when the pauperization of Germany is progressing apace and the utilization and exploitation of the productive capacity of the industry has been diminished by well nigh 50 per cent. Does this tendency for increase of power and expansion spring from a deeper cognition of future indispensable conditions which are to determine the continuance of Germany as an industrial state? Or does it but conceal an intensely nervous uneasiness, the fear of the imminent disintegration of the mighty structure built up during the past decades, that is looking for an expedient to save the sinking ship?

Opinions Vary With Events

The best brains of Germany are hard at work to solve the vast problems confronting that country and yet it would appear as if the utterances and opinions of leading industrialists are at variance with actions and events—a rather pessimistic judgment of the future aspect of Germany's economic development on one hand and a creative activity almost unsurpassable and certainly without parallel in the history of industrial Germany on the other!

German Enterprise Unbounded

One ought to think that the conviction prevailing in Germany—that the industry is doomed to ruin under the crushing terms of the Peace Treaty—has produced an atmosphere of despondency and half-heartedness, tending to paralyze all energy and rendering the execution of projects on a giant scale impossible. Instead, an unbounded enterprise "unternehmungslust" is noticeable, likely to deceive anyone who has not made a close study of the conditions obtaining in the German industry. There is no gainsaying the fact that the latest developments in Germany are an imposing manifestation of strength, but this very manifestation should not blind one to the fact that a development on such lines was largely rendered possible by the enormous inflation obtaining in Germany, and the moment the government orders the printing presses to be run at say, half speed, the industry is sure to lose the ground for business transactions of a kind which may rightly be classed under the heading of "inflation phenomena."

Socialization and Labor

The most active of all the leading industrialists is a man who, though being well known in international industrial circles for years past, gained wide prominence even in lay circles through his remarkable speech and attitude at the Spa coal conference—Hugo Stinnes. Some weeks ago he submitted to a committee of the "Reichswirtschaftsrat" (Federal Economic Council, i.e., the German National Industrial Parliament) a program embodying the essential points for a socialization plan as he conceived it and shortly afterward one of the most remarkable financial transactions of late became known: the interest agreement between the Stinnes group and the Siemens-Schuckert concern. It is highly interesting and instructive to note that the recommendations of the sub-committee appointed by the Federal Economic Council—and presided over by Stinnes—for the adoption of the committee's socialization scheme are generally framed on the lines that formed a basis of the Stinnes-Siemens-Schuckert agreement. While even two labor members of the committee were supporting Stinnes' plan, it would be misleading to infer that organized labor is whole-

heartedly in favor of a socialization scheme as outlined by Stinnes. On the contrary, a decided opposition is noticeable in labor circles toward the salient point in the Stinnes' proposal: Profit sharing of the workers on the "small share" basis. It is held that whatever advantages there may be in labor's participation in profit sharing by the issuance of small shares, such a plan merely represents a substitute for socialization," inasmuch as the worker would always regard his dividends as a mere part of the wages due to him.

However, it is important to point out right here that the Stinnes' proposal does not provide for a commonable amalgamation of congenerous works brought about by the influence of the state. His plan of increasing the productive capacity of the industry is based upon the so-called "vertical combination" of plants—that is, the joining of raw material works with the wholesale consumers—and the whole scheme to be run on private-capitalistic lines the same as the transaction with the Siemens-Schuckert concern.

Combination of Electrical and Mining Concerns

As regards the latter, it is for the first time that an important concern of the electrical industry enters into close relation with the mining industry and it is instructive to note that the interest agreement not only provides for a sufficient supply of raw material but covers joint accounting and distribution of profits as well.

Stinnes suggests the coalition of all consumers of coal, be it in the form of water, gas, electricity, or traffic; and one may not be far off the mark in assuming that in suggesting this plan for the formation of mixed works he expects an abatement of the existing discontent among coal consumers, springing from high prices, as soon as the latter are participating in the profits made by the collieries. Cheapening of production may be another determining factor of his proposed plan. It seems rather unlikely that Stinnes intends to confine this trustification to coal and iron for indications are pointing to an extension of the scheme so as to embrace the iron industry and the refining and manufacturing industries as well. This is no mere conjecture but fully borne out by events and facts.

Expansion of Iron Works

The iron works in general — and particularly those belonging to the Stinnes' concern—have during the last year displayed a steadily increasing tendency for expansion in two directions: on the one hand they took a marked interest in collieries and o. the other they aimed at a closer relation with the manufacturing industry. This tendency is strikingly illustrated in the interest agreement between the "Rein-Elbe-Union" and the "Siemens-Schuckert" concerns. The Rhein-Elbe-Union represents an amalgamation of the "Deutsch-Luxemburgische Bergwerks-und Huetten Aktien Gesellschaft" and the "Gelsenkirchener Bergwerksgesellschaft," the former producing chiefly iron while the latter is largely engaged in mining. The latest addition to the concern is the "Bochumer Gussstahl Verein." These works have now proceeded to strengthen their relation to the wholesale consumers, and the Siemens-Schuckert concern may be regarded the first link in the chain.

The official communique issued by the Siemens-Schuckert company justifies the step taken in this direction by stating that "it is of utmost interest for the electrical industry to gain a certain influence upon the raw material works with a view to insuring a supply of raw material and semi-finished products of a quality as will enable it to cheapen production and raise its products to the acme of perfection."

From the aforementioned statement it would appear that the advantage of transactions of such a kind were largely on the side of the manufacturing industry and it cannot be denied that the present shortage of coal and quality iron tells heavily upon the electrical industry. The question is, however, whether the present state of affairs will continue indefinitely? In this connection it is important to reflect upon the statement made some time ago by General-Manager Peter Kloeckner of the "Hasper Eisen-und Stahlwerk." In the course of his statement—which made a profound impression in Germany—he drew a gloomy picture of the future aspect of the German mining industry, pointing out that France and Belgium are getting swamped with German coal as a result of the Peace Treaty, in consequence of which the iron industry of the aforementioned countries was in a position to offer her products at lower prices than Germany.

The German coal deliveries to the Allies were thus not only aggravating the coal famine at home but were also instrumental toward the ousting of German products from the world's markets, he averred. This statement is not without a certain significance! Should it prove true, German iron consumers will soon cease complaining about the difficulty of getting supplies and the advantage of the interest association will wholly be on the side of the iron works which are thus finding a convenient outlet for their production. For a long time to come German export trade will be confined to finished products, a large part of the price of which will be absorbed by wages. This, however, is principally the case with the products of the electrical industry but not with the staple products of the iron works and while it should not be denied that Stinnes' proposal has also national and economic interests at heart, the private-capitalistic trend of the suggested "vertical combination" stands out in bold relief.

Future Trend Impossible of Prediction

It is impossible to predict with any fair degree of accuracy the future trend of present developments but sight should not be lost of the fact that the socialization problem has ceased to be a mere economic question. It has become a political platform of the first magnitude and, of course, a first-rate propaganda stock tale of the laborites. The conviction is however steadily gaining ground—even among the saner elements of the working class—that socialization on purely socialistic principles would turn out to be a dangerous experiment at the present time. The strength of organized labor in Germany, on the other hand, constitutes a factor which it would not be wise to ignore. Probably some sort of a compromise will be arrived at. It is significant, however—and not without a certain ironical touch — that at a time when the parties determined on crushing capitalism are as strong as never before, private capitalism is extending its sphere of influence day by day.

What Happened to Building Material Prices and Wages in 1920?

The year 1920 opened with building material prices high; they had reached their peak, many people thought. Then they proceeded to climb still higher, until mid-summer showed an average advance of about 40 per cent over what they were at the beginning of the year. This advance was the cause of its own downfall. The demand dropped off sharply, because owners would not build in the face of such prices, and the banks refused to loan money on building investments that could not hope to amortize the excess cost of the structure before the value of the property would be depreciated by the return of normal building costs.

The end of the year finds a reduction in the price of cement, brick, lumber and steel as compared with the peak prices, and the prices of some of the other materials are softening and further declines are expected, but today the general average in material costs is somewhat higher than it was at the beginnin ; of 1920.

Building material prices may be divided into two classes: those which have been normally high, and those which have been abnormally high. The general economic situation of the country, including the average drop of some 35 per cent in wholesale commodity prices for the year, has had its effect in reducing normally high building prices, while investigations and the pressure of public opinion is beginning to knock the props from under those abnormally high prices which have been maintained by unlawful combines and trade "agreements."

We look for a stabilization of material prices at lower levels in the late spring and early summer, when building activity will be revived under the encouragement of these lower prices.

Some upward trend, even, may result from this increased building program, but 1920 peak prices will certainly not be seen again.

The beginning of 1920 found wages in the building trades also high, and on May 1 there was a wage increase in practically every trade. Those not raised on May 1 were advanced on Oct. 1, so that wages in all building trades are higher today than a year ago. In the face of a marked and continuing decline in living costs and a reduction in wages in many other lines of industry, the present wage scale cannot be justified much longer. A softening of the scale is already evident in unorganized and common labor circles. Union labor, however, operates under term agreements which fix the wage scale for definite periods. It will resist any wage decrease to the last, but it must unquestionably adjust itself to the new conditions.

Contractors, like manufacturers, are rejoicing in the decrease in labor unit costs, due to the marked increase in the efficiency of labor, even though the wage scale is not changed. Whether this increased efficiency will be sufficient to keep wages at their present levels, however, is doubtful. Only the future will tell.

The Lockwood Committee investigation has had a very healthy influence on the building business. Temporarily it has tended to check construction, and certainly has revealed some ugly conditions, but this much-needed surgical operation will leave the business as a whole cleaner and healthier than ever before.

The elimination of the evils of trade "agreements" in both material and labor practices will enable contractors to quote lower prices and give their clients better service, which will result in a decided benefit to the community as a whole.—*From a statement issued by the George A. Fuller Co.*

$25,000,000 Locomotive Plant for St. Louis

The American Locomotive Co. plans to build a large plant in St. Louis on which the expenditure may reach $25,000,000, according to the *New York Times*. It is understood that the initial cost will be between $5,000,000 and $10,000,000 and that future additions will make the plant one of the largest units in the company's system. The company already has extensive plants at Schenectady and Dunkirk, N. Y.; Richmond, Va.; Pittsburgh, Montreal; Paterson, N. J., and Chester, Pa. The erection of a plant at St. Louis will create a manufacturing unit further west than any now owned.

Negotiations for the acquirement of land in the St. Louis industrial section have been going on for some time, and it is understood that options have been secured on four tracts, each of about 200 acres. One tract comprising about 205 acres is said to be favored, as the location affords the best of traffic facilities.

All of the options are on land in a relatively small radius. The best tract is located between Granite City and Madison and lies close to the Wabash and Terminal railways.

Near by is the plant of the American Car and Foundry Co., and the St. Louis Coke and Chemical plant also is near at hand, so that a fuel supply is assured. It is understood that efforts to bring the American Locomotive Co. to St. Louis have been under way for several years. There is no intimation as to when the company will start building, but it is thought that this will not be long postponed.

It is believed that the building of a Middle Western plant by the company is in anticipation of a big demand for railroad equipment in the next several years. The railroads are admittedly in need of equipment, the only obstacle to free purchasing being inability to finance the equipment. Furthermore, there is a belief that prices will come down during the next few months. Aside from this, it is agreed that there is a big shortage both as to cars and locomotives.

Railways Urge Immediate Shipment

Shippers who are in a position to do so are being urged by the railroads to take advantage of the present surplus of equipment and, by shipping now, secure prompt movement and delivery of commodities.

For the first time since pre-war days the carriers are now ahead of the nation's business, a condition which is attributed to three factors. First, strenuous and successful efforts on the part of the carriers to rehabilitate their properties; second, the usual winter lull, and third, the present changing industrial conditions.

Railroad men point out that the present large surplus of freight equipment will not be available in the spring when the annual crop movement develops, and for this reason those who are in a position to anticipate their needs will find it to their advantage to "ship now and avoid the rush."

Fourteenth Annual Meeting of American Society of Agricultural Engineers

That modern application of engineering to the services of agriculture is largely a matter of designing the requisite farming machinery, was the thought brought out at the fourteenth annual meeting of the American Society of Agricultural Engineers, held in Chicago on Dec. 28, 29 and 30, 1920. The meeting had been arranged by the retiring officers including, president, F. N. G. Kranich, Hyatt Roller Bearing Co., Chicago; vice-president, F. W. Ives, of the Ohio State University, Columbus, Ohio; and secretary-treasurer, J. B. Davidson, Iowa State College, Ames, Iowa.

The program covered a wide variety of subjects among which may be briefly mentioned: Wagon Standards, Factors Influencing the Draft of Plows, Wood Preservation, Tractor Testing and Stationary Engines. All papers presented at the meeting will be reprinted in the *A. S. A. E. Journal*.

The officers for the ensuing year were announced as: President, E. A. White, Farm Implement News, Chicago, Ill.; first vice-president, W. G. Kaiser, Portland Cement Association, Chicago; second vice-president, E. R. Jones, University of Wisconsin, Madison, Wis.; secretary-treasurer, Frank P. Hanson, Station A, Ames, Iowa.

The Undistributed Earnings Tax Plan

The committee on federal taxation of the National Association of Credit Men has issued a book entitled "The Undistributed Earnings Tax—a plan to tax the current year's earnings of corporations not distributed." This tax is designed to take the place of the Excess Profits' Tax.

Copies of this book have been sent to every member of Congress and to thousands of business men throughout the country.

The recommendations of the committee are:

1. Elimination of the Excess Profits Tax.
2. Elimination of the Corporation Income Tax.
3. Dividends from current earnings to be subject to the normal tax in the hands of the individual.
4. Substitution of a corporation undistributed earnings tax at graduated rates.
5. Dividends which are paid from earnings of prior years on which the corporation has paid the undistributed earnings tax, not to be considered as income to the individual shareholder. Dividends may not be paid from surplus until earnings of current year have first been used for that purpose.
6. Adjustment of rates of taxation on personal incomes (both normal and surtax) to meet the requirements of the budget from income taxes.

The elimination of the Excess Profits' Tax is said to be recommended by the committee because it believes that the Excess Profits' Tax discriminates against various types of business, that it exercises a repressive effect on industry, and that it violates the principle of taxation in accordance with ability to pay.

Roy G. Elliott, chairman of the committee, says: "That a substitute for the Excess Profits' Tax should not only yield a substantial portion of the revenue lost by the repeal of this tax but should equalize the distribution of the tax burden. To insure equality of distribution, the committee believes that the individual must be considered, wherever it is practicable, as the tax paying unit, for, since in the last analysis the individual bears the taxes, it is only by considering him as the tax bearing unit that quality of distribution may be obtained.

"The committee therefore recommends that the Corporation Income Tax be eliminated, and that each individual shareholder be made to pay his own normal tax upon dividends, instead of

having it withheld and paid by the corporation.

"If the Excess Profits' Tax is repealed and the Corporation Income Tax is eliminated, absolute equality of distribution will exist, it is claimed, with respect to all the distributed earnings of sole traders, partnerships and corporations. But sole traders and partners are taxed not only on the earnings distributed to them but on their total earnings, whether distributed to them or not. With the elimination of the Excess Profits' Tax the corporate shareholders would be taxed only on the earnings distributed to them; thus a fairly substantial portion of corporate earnings would remain untaxed. The committee proposes that these undistributed earnings of corporations be taxed at rates substantially equivalent to those that would be applied, if this income were assessable in the hands of the shareholder. Under the proposed law the corporate shareholder will have paid for him by the corporation a tax on the income undistributed to him at substantially the rate that would apply to this income if it were distributed to him. The specific recommendation reads "that a graduated tax at rates comparable with the normal and surtax rates paid by individuals and partners on the earnings of their business which are reinvested or remain undistributed, should be paid by corporations upon the current net income not distributed in dividends or made subject in the hands of the shareholders to the individual income tax.

"The purpose of this tax on the current net income of corporations which is reinvested or remains undistributed, is simply to tax that portion of the earnings of the investment of the individual shareholder which, assuming the repeal of the Corporation Income and Excess Profits' Tax, otherwise entirely escapes taxation by reason of not being distributed. This tax should be so levied as to be free from any punitive element and from any attempt to force the distribution of dividends which should, for sound business reasons, be retained as working capital.

"The Committee feels, giving weight to both the considerations of equity and simplicity, that the most desirable factor on which to base this undistributed earnings tax is the percentage of the total current net income which remains undistributed, and considers this factor as being of the greatest importance in seeking equality as between different individuals who prosper equally."

Foreign Trade Financing Committee Progressing

Following a meeting of the executive committee of the committee on organization of the Foreign Trade Financing Corporation recently, announcement was made that temporary quarters had been leased for the corporation at 66 Broadway, New York, and that a staff is at work on the preliminary plans of organization.

The committee gave out the following statement:

"The committee on organization of the Foreign Trade Financing Corporation, through its executive committee and various special committees, is proceeding actively with its work preliminary to presenting the final plans for the corporation to the public, and calling for subscriptions to its capital stock. The crystallization of a definite policy in this respect and of the scheme of operation of the new institution has progressed successfully.

"A carefully thought-out plan relative to the matter of stock subscriptions and designed to reach every element in our commercial organization will shortly be announced. This has been developed with the greatest attention to the section of the resolutions of the Chicago meeting, urging the co-operation of all members of agricultural, manufacturing, financial and labor interests throughout the country and in the firm conviction that every member of our producing and business organization is connected with the welfare of our foreign trade.

"It has further been developed with attention to the necessity of making clear the need for an organization of such magnitude in our present commercial structure. Adequate machinery for the extension of long-term credits to foreign customers is essential to the future prosecution of our foreign trade, as a continued foreign trade is vital to our domestic welfare."

The executive committee is acting for the committee of thirty appointed by the nation-wide meeting of bankers, producers and business men in Chicago last month to carry out the establishment of the proposed corporation.

Across the United States in a Day

The War Department announces that on Washington's Birthday, Feb. 22, 1921, an attempt will be made by the Army Air Service to fly from coast to coast within a period of twenty-four hours.

The present plans call for a plane to leave Jacksonville, Fla., and at the same time for another to start from San Diego, Cal. The distance to be flown will be 2,079 miles, and stops will only be made at Ellington Field, Houston, Tex., and El Paso, Tex. The pilot who will fly the plane from San Diego, Cal., has not as yet been selected but Lieutenant Alexander Pearson, Jr., will guide the plane which leaves Jacksonville, Florida. The distances between stopping places are as follows: From Jacksonville, Fla. to Houston, Tex., 804 miles; from Houston to El Paso, Tex., 660 miles, and from El Paso, Tex. to San Diego, Cal., 615 miles.

The Krupp factories have declared a gross profit for the year of 159,000,000 marks, as compared with 11,700,000 marks in 1919. The net profit is 79,500,000 marks.

National Highway Transportation Exposition Fills Two New York Armories

The armories of the 13th New York Infantry and the 1st Field Artillery were filled during the week of Jan. 3 to 8 with the motor truck and accessory exhibits making up the New York show of the Motor Truck Association of America.

By long odds the most spectacular exhibit was that of the army. In it were included a fully equipped military airplane, Liberty and Hispaño aviation engines, airplane cameras and equipment, an artillery tractor with heavy trailer, the Christie self-propelled 155-mm. gun mount which was shown at the S. A. E. convention last spring, an anti-aircraft gun on a motor truck chassis, two mobile machine shops, etc.

The army also had a battery of six motion-picture cameras showing pictures simultaneously side by side on the same screen on phases of army life.

In general there were few changes in design and construction in the standard trucks. There was, perhaps, a wider use of the larger sizes of pneumatic tires.

Among the novel features were a Reo speed wagon fitted with flanged wheels and an omnibus body for railroad work, and the Adams company trailers that provide a comfortable, though small, bungalow on wheels to attach to the rear of an automobile and make hotels superfluous to the tourist.

Merchants Association Opposes Curb on Immigration

In accordance with the recommendations of its committee on immigration and naturalization the Merchants' Association of New York has addressed a letter to the Senators from New York and to Senator Colt, chairman of the Senate Immigration Committee, in opposition to the Johnson bill, which has been passed by the House of Representatives. This bill would suspend immigration for one year.

The letter of protest reads:

The Merchants' Association of New York earnestly urges that you do not support the Johnson bill, designed to exclude immigrants for one year, which has recently passed the House of Representatives.

This association's committee on immigration and naturalization has just completed a comprehensive study of the whole question of regulation and restriction of aliens and has come to the following conclusions:

The primary purpose of any plan to regulate immigration should be to protect and promote the best interests of this country. Due consideration must, therefore, be given to social, political and economic conditions in the United States, as well as to the character and assimilability of the peoples seeking admission to this country.

In order to safeguard our social and political welfare, adequate laws have already been enacted to prohibit the immigration of such generally recognized undesirables, as criminals, the physically and mentally unfit, and those advocating the destruction of government. These laws were substantially strengthened last spring by the passage of additional legislation, applying particularly to radicals.

In the light of these facts, the Merchants' Association of New York recommends that emphasis at this time be placed not on the addition of further restrictive measures, but rather on the efficient administration of those already on the statute book.

James H. Matthews & Co. Gives Employees Insurance Policies

On Friday morning, Dec. 24, each worker rounding out a year or more of service for the Jas. H. Matthews & Co., Pittsburgh, Pa., was given an insurance policy on his life. This insurance plan calls for increased amounts depending on the years of continuous service to a maximum policy in five years. One of the things which shows the loyalty and feeling of good fellowship among the Matthews workers is that 64 per cent of the workers benefit by this plan and 21 per cent are given maximum policies.

In addition, other gifts were distributed to those of less than a year's service and some of the older members were rewarded with special gifts.

So Christmas at Matthews is, as usual, one to remember and one in which each worker, from the oldest to the youngest and from top to bottom, has had a good share.

To "Scrap" Freight Congestion Evils

Super-costly freight terminals, delayed tonnage and losses which follow in the wake of freight congestion, are economic evils which are to be "scrapped" under plans now being worked out by the transportation committee of the Federal Highway Council.

At a meeting of this committee in New York under the chairmanship of W. J. L. Banham, general traffic manager of the Otis Elevator Co., traffic managers from all important centers of industry were in attendance. It was decided after due deliberation, to "draft" one or more cities in the United States and put what is known as store-door delivery to a final test. Such form of delivery, it was explained, was the use of the motor truck and highway in conveying freight direct to the door of the consignee, instead of allowing tonnage to accumulate in warehouses, thus adding to congestion and financial loss which ultimately come out of the consumer's pocket.

Definite action was taken by the adoption of the following resolution, presented by J. C. Lincoln, manager of the traffic bureau of the Merchant's Association of New York:

WHEREAS: It is the view of the Transportation Committee of the Federal Highway Council that relief from congestion and delay that normally prevails at railroad delivery stations in the handling of merchandise freight requiring station or platform service can only be secured by the introduction of a system for store-door delivery.

BE IT RESOLVED THAT: The subcommittee on Store-Door Delivery be instructed to take the matter up with the carriers and shipping interests at one or more points to be selected by them with the end in view of inaugurating a store-door delivery plan at such point or points together with rates, rules, and regulations under which it should be operated; and

BE IT FURTHER RESOLVED THAT: They are hereby instructed to report to the general meeting of the Transportation Committee a concrete plan for its approval.

Prior to the adoption of the resolution, A. E. Beck, general traffic manager of the Merchants and Manufacturers' Association at Baltimore, outlined the store-door delivery system as tested in that city.

The motor truck in terminal work was presented by B. F. Fitch, president of the Motor Terminal Co. of Cleveland, Ohio, which company has successfully established at Cincinnati a system of auxiliary transportation that promises practical relief to other cities.

The American Railway Association was represented by F. E. Williamson, general superintendent of the New York Central, and Colonel Chas. Hine of New York, representing the president of New York, New Haven and Hartford. The American Express Co. was represented by F. S. Holbrook, vice president and treasurer, and T. H. Stoffel represented the American Electric Railway Association.

Business Items

The Mesta Machine Co., Pittsburgh, Pa., has announced the opening of a branch office at Chicago, Ill. The offices are temporarily located in the Railway Exchange Building, but will be moved to permanent quarters in the McCormick Building after April 1. The Chicago office will be in charge of C. J. Mesta, second vice-president of the company. Messrs. W. R. Dawson and R. W. Schutte will be transferred from the Pittsburgh office to Chicago. This company has also recently opened offices in the Singer Building, New York, in charge of M. M. Moore who was formerly export sales manager. Frank A. Mesta will be transferred from the Pittsburgh office to the New York office as assistant to Mr. Moore.

The Seifert Special Machine Co., Hartford, Conn., has recently changed its name to the Sexton Machine Co. The firm is located at 308 Pearl Street.

The Wallace Barnes Co., Bristol, Conn., manufacturer of steel springs, etc., has announced the increase of its capital stock from $510,000 to $2,040,000.

The Peck Manufacturing Co., New Haven, Conn., has recently been organized and incorporated with a capital stock of $75,000 to deal in machinery, machine tools, etc.

The Goodwin Manufacturing Co., Hartford, Conn., recently organized, has been incorporated with a capital of $50,000 to manufacture machinery, etc.

The Waterbury Tool Co., Waterbury, Conn., manufacturer of gears, etc., has announced the increase of its capital stock from $500,000 to $1,000,000.

The Northern Engineering Works, Detroit, Mich., has established a new office at 990 Union Arcade Building, Pittsburgh, Pa. J. B. Laird, who has hitherto represented the company in western New York and northern Pennsylvania, will have entire charge of this office.

The Chicago Pneumatic Tool Co., New York, announces the appointment of J. F. Huvane as Eastern manager of compressor and engine sales, with headquarters at 6 East 44th St., New York, and G. C. Vanden Boom as Western manager of compressor and engine sales, with headquarters at 300 North Michigan Blvd., Chicago.

J. T. Roche, formerly vice-president and general manager of the Locomobile Co. of America, Bridgeport, Conn., A. L. Riker, formerly vice-president and chief engineer, and H. H. Edge, formerly general works manager, have formed a corporation under the laws of the State of Connecticut, known as the Investing and Manufacturing Co., with offices in the First Bridgeport National Bank Building, Bridgeport, Conn.

Slater & Barnard, Ltd., Ottawa, Ont., Can., has changed its name since January 1, 1921, to N. Slater Co., Ltd.

Export Opportunities

The Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C., has inquiries for the agencies of machinery and machine tools. Any information desired regarding these opportunities can be secured from the above address by referring to the number following each item.

The representative of a company in North China is in the United States and desires to secure an agency for the sale in Mongoli and North China of farming implements and machinery, iron and steel products, chemicals, automobiles and trailers, flour-mill machinery, textile machinery, and soap-manufacturing machinery. Reference. No. 34,227.

An American firm having a representative in Japan desires to secure an agency for the sale of machinery, tools, hardware, and iron and steel products. Reference. No. 34,235.

The representative in the United States of a trading company in New Zealand desires to purchase agricultural implements, machinery, hardware, etc. Quotations should be given f.o.b. American ports. Terms to be cash. Reference. No. 34,233.

Forthcoming Meetings

The Cleveland Section of the American Society of Mechanical Engineers will hold a meeting in the Cleveland Engineering Society's Rooms on Feb. 1. R. R. Abbott, of the Peerless Motor Car Co., will speak on the "Uses of Alloy Steel in the Machine Tool Industries."

The Society of Automotive Engineers will hold a meeting in Chicago on Feb. 2 at the Hotel Morrison in connection with the Chicago Automobile Show; also one in Columbus on Feb. 10 at the Winter Garden, New South Hotel, in connection with the Tractor Show.

The Engineering Institute of Canada will hold its thirty-fifth annual meeting in Toronto, King Edward Hotel, on Feb. 1, 2 and 3.

A triple convention of the National Supply and Machinery Dealers' Association, the Southern Supply and Machinery Dealers' Association and the American Supply and Machinery Manufacturers' Association will be held in Atlantic City, N. J., May 16, 17 and 18, 1921, with headquarters for all three associations at the Marlborough-Blenheim. F. D. Mitchell, 4106 Woolworth Building, New York, is secretary of the last-named association.

The Spring Convention of the National Machine-Tool Builders' Association will be held on Thursday and Friday, May 19 and 20, at Hotel Traymore, Atlantic City, N. J. The general manager is Ernest F. DuBrul, 817-818 Provident Bank Building, Cincinati.

The Industrial Cost Association will hold a meeting, to organize a New York section, in the rooms of the A. S. M. E., 239 West 39th St., New York City, on Jan. 20, at 8 o'clock.

Condensed-Clipping Index of Equipment

Patented Aug. 20, 1918

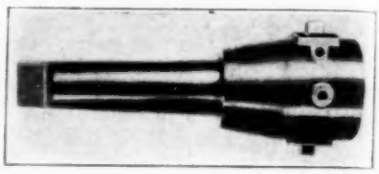
Solders

Rohde Laboratory Supply Co., 17 Madison Ave, New York.
"American Machinist," Dec 16, 1920.

"Al-Solder" is made by this company for work on sheet aluminum, lap joints, seams and general repairs in aluminum. This solder comes in the form of white, deliquescent sticks and contains all of the flux necessary for its use. "Tensil" solder is intended for lapping and joining iron, brass, lead, nickel, tin and zinc. The joined parts must, however, first be tinned with "Al-Solder." For work on aluminum castings "Nuflux" solder is recommended for filling up blowholes and pittings. "Clean-Al" is intended for cleaning and de-oxidizing molten aluminum. For soldering cast iron "Relasco" solder can be furnished. "Silva" solder is of gray color and can be furnished for use on non-ferrous copper alloys and german silver. These solders vary in melting point from 650 to 1,250 deg. F., the color and the tensile strength also varying. It is claimed that homogeneous joints of great strength are made. For use on jewelry and scientific instruments a sterling silver solder is also made.

Boring Bar, Expanding, "VV"

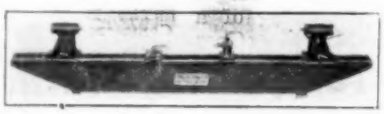
H. A. Hopkins & Co., Inc., La Salle West and La Porte Aves., South Bend, Ind.
"American Machinist," Dec. 16, 1920.



The bar is made in two styles, type "A" being used for holes from 1 to 2½ in. in diameter and type "B," shown, for holes from 3 to 12 in. in diameter. It can be furnished with either straight or taper shank and either plain or with a pilot bar. Square toolbits are used. For the bars boring holes 3 in. in diameter or larger, regular commercial toolbits can be utilized, so that worn cutters can be easily replaced. To change the boring diameter the conical-pointed screw is adjusted. The screw opposite it is then tightened to clamp the cutters in place.

Centers, Bench

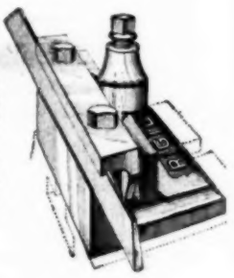
Cadillac Tool Co., 268 Jefferson Ave., Detroit, Mich.
"American Machinist," Dec. 16, 1920.



The bed is a ribbed casting of box-form construction, the ways being scraped. Both stocks may be moved to suit different lengths of work, and when adjusted can be clamped in place by means of levers. The right stock has a spring-actuated spindle that engages the work with sufficient pressure to eliminate play or lost motion between the centers. A fixture for holding a dial indicator is fitted to the bed. The 9- and 12-in. swing bench centers are furnished with stock rests also. Specifications: Made in seven sizes: 6 x 18 in., 6 x 36 in., 9 x 36 in., 9 x 48 in., 12 x 36 in., 12 x 48 in., and 12 x 60 in.

Cutting-Off Tool, "Back-Stroke"

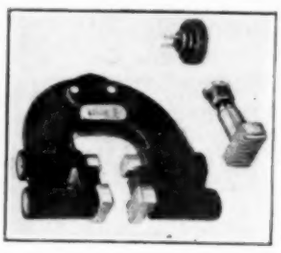
Rigid Tool Holder Co., Washington, D. C.
"American Machinist," Dec. 16, 1920.



This device consists of a narrow tool of high-speed steel held by a hardened steel clamp on the base of the holder, which is a steel casting. The tool can be held by the toolpost of a lathe and swung to cut on either the right or the left, the cut being made from the rear. It is claimed that the blade is always held erect and that it can work very close to a chuck or steadyrest.

Gage, Snap, Thread, Adjustable, "Wickman"

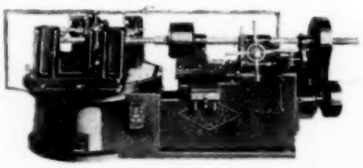
Alfred Herbert, Ltd., 54 Dey St., New York City
"American Machinist," Dec. 16, 1920.



The gap between the anvils of this gage can be adjusted with an accuracy of 0.0001 in., each anvil having an adjustment of ¼ in. Sets of frames are thus made in ¼-in. steps, the anvils for all pitches being interchangeable in them. It is thus possible to gage screws of any diameter and with any limits required. The distance from the top of the thread to the pitch diameter is marked on the "no-go" anvils, so that, with the help of plugs or gage blocks, it is possible to accurately determine and set the pitch diameter of the gage.

Boring Machine, Horizontal, Heavy-Duty

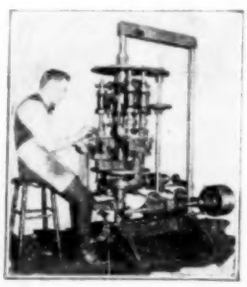
Rockford Drilling Machine Co., Rockford, Ill.
"American Machinist," Dec. 23, 1920.



This machine is intended for work encountered in the automotive field, particularly the machining of crankcase bearings. The machine bores simultaneously two crankshaft bearings 2⅞ in. in diameter by 2⅜ and 2⅛ in. long respectively, and three camshaft bearings in aluminum at a cutting speed of 200 ft. per minute and 0.010 in. feed per revolution of the spindle. It is said that the machine can be easily arranged to take care of holes from 1 in. in diameter in steel to 12 in. in cast iron and aluminum. It is rated at a capacity of 2¼ in. in diameter when drilling from the solid in steel. The feed and drive mechanisms are completely mounted on one base section and the fixtures holding the work are mounted on the other section.

Chucking Machine, Vertical, Automatic, "Jackson"

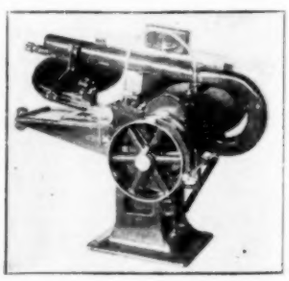
Long-Henkel Manufacturing Co., Reading, Pa.
"American Machinist," Dec. 23, 1920.



Intended for drilling, threading, turning, facing, etc., in the quantity production of small parts, such as nuts, pulleys, pipe fittings, battery terminals and electrical fixtures. The machine is built in three types, the illustration showing "Type B," one of the reciprocating kind. This type has four duplex automatic chucking vises and three pairs of working spindles, being adapted to work requiring drilling or boring, drilling to size, and then threading or tapping. The chucking vises automatically eject the finished articles, and after the operator puts the unmachined parts in place the vises close automatically. The floor space required is 3 x 5 ft., and the approximate weight is 1,450 lb.

Cutting Machine, Metal, "Horizontal Junior"

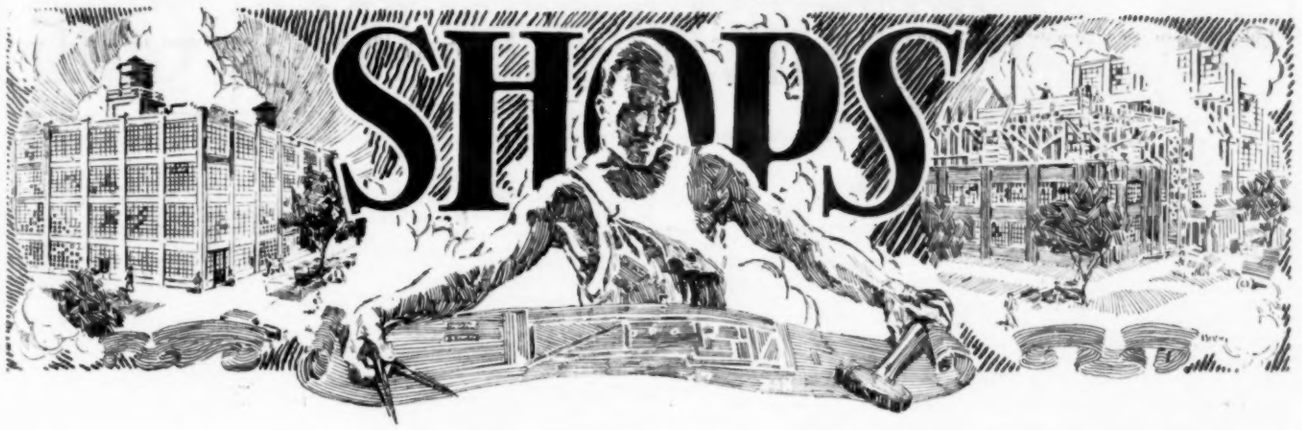
Metal Saw and Machine Co., Inc., Springfield, Mass.
"American Machinist," Dec. 23, 1920.



The cutting is done by means of a bandsaw mounted almost horizontally on a frame that can be swung in a vertical plane in order to raise the saw. A capacity for work up to 4 x 4 in. is provided, the machine being a general-purpose, quantity-production tool. Specifications: Capacity, 4 x 4 in. Saw: length, 8 ft. 4 in.; width, ¾ in.; thickness, 0.032 in.; kerf, 0.047 in. Cutting speed, 120 ft. per minute. Speed of drive pulley, 250 r.p.m. gravity feed. Height, floor to table, 26½ in. Floor space, 2 ft. 8 in. x 4 ft. 6 in. Weight: net, 425 lb.; crated, 500 lb.; boxed for export, 625 lb. Export box, 54 x 32 x 40 in.

Clip, paste on 3 x 5-in. cards and file as desired

NEW *and* ENLARGED



Machine Tools Wanted

If in need of machine tools send us a list for publication in this column

D. C., Washington—The Bureau of Supplies & Accounts, Navy Dept.—two 14 in. x 36 in. grinders, 2 in. wheels, motor driven, for the Brooklyn Navy Yard, Brooklyn, N. Y.

D. C., Washington—The Bureau of Supplies & Accounts, Navy Dept.—two 14 in. x 36 in. grinders, 2 in. wheels, motor driven, for the California Navy Yard.

N. Y., New York (Borough of Bronx)—H. Medalis, 961 Washington Ave.—lathes, millers, drills and shapers for machine shop.

N. Y., Watertown—The T. N. C. Motor Sales Co.—lathe, drill press, miller and other machine tools suitable for garage repair work.

Pa., Philadelphia—The Amer. Eng. Co., Sepviva St. and Wheatsheaf Lane—machine tools.

Pa., Philadelphia—J. G. Neidinger Co., 1309 North 2nd St., manufacturer of shears and florists supplies—die cutting machine.

Va., Ashland—T. & B. Auto Service Co., H. Bermpass, Purch. Agt.—mechanical outfit for new auto repair shop.

Ill., Chicago—The Blaze Mfg. Co., 743 First Natl. Bank Bdlg.:
No. 410 and No. 408 Bliss press, or 796 ½ Toledo, 108 in. Minimum capacity.
No. 205-F. Toledo, 72 in. to 80 in. capacity, or equivalent of other make.
No. 24-D. Toledo, 48 in. to 54 in. or equivalent of other make (new or used).
Also additional equipment for the manufacture of sheet metal burial caskets.

O., Cincinnati—The Wides Pipe & Supply Co., 1324 Freeman Ave.—1 double head nipple threading machine which can be used for threading close, short and long nipples from ¼ in. to 2 in.

Wis., Green Bay—The Green Bay Drive Calk Co., 9th and State Sts., F. Van Laanen, Purch. Agt.—forge shop equipment.

Wis., Milwaukee—P. Goldmann, 786 22d St.—tin working machinery.

Wis., Milwaukee—The Modern Grinder Mfg. Co., 49 Oneida St., A. Strauss, Secy.—2 polishing heads.

Wis., Wisconsin Rapids—The Amer. Rotary Engine Co.—lathes, shaper and other air compressor machinery.

Wis., Two Rivers—R. G. Suetlinger—sheet metal working machinery.

Wis., Sturgeon Bay—Wolter & O'Boyle—additional machine shop equipment for ship yard.

Minn., Duluth—The Clarkson Coal & Dock Co., Birch Ave. and Rices Point, J. Davidson, Purch. Agt.—machine shop equipment and crane for Superior, Wis.

Tex., Fort Worth—The Fort Worth & Denver City R.R., Denver Record Bldg., E. Clarity, Genl. Mgr.—miscellaneous equipment.

Cal., Gridley—The Freisley Aircraft Corp., Box 368, B. M. Spencer, Chief Engr.—complete machine and wood-working equipment, to include lathes, millers, grinders, punch presses, furnaces, drill presses, planers, shaper, rip-saw, joiners, band saw glue presses, etc.

Machinery Wanted

O., Cleveland—The City Ice Delivery Co., Cadillac Bldg.—ice making machinery for new plants.

Wis., Fond du Lac—The Latex Tire & Rubber Co., East Scott St., G. Lambright, Purch. Agt.—rubber mill vulcanizers.

Wis., Seymour—The Seymour Woodenware Co., S. A. Konz, Purch. Agt.—sectional roll planer.

Wis., West Allis—The School Bd., F. Haker, Pres.—additional manual training machinery.

Que., Quebec—Price Bros., 56 St. Peter St.—equipment for its sawmill at Montmagny.

Ont., Stratford—The Canadian Cereal & Flour Co., Ltd., George St.—grinding machines, sifters and other flour mill machinery for its Tillsanbury plant.

Metal Working

NEW ENGLAND STATES

Conn., Bridgeport—C. H. Gregory, 303 Clinton Ave., has awarded the contract for the construction of a 1 story, 32 x 100 ft. factory on East Washington Ave., for the manufacture of metal products. Estimated cost, $20,000.

Conn., New Haven—New York, New Haven & Hartford R.R., Meadow St., has awarded the contract for the construction of an addition to its machine shop at Cedar Hill Yard. Estimated cost, $225,000.

Mass., Boston—The Massachusetts Ave. Station Garage 2355 Massachusetts Ave., will soon award the contract for the construction of a 5 story garage, to cover 22,000 sq.ft. of floor space. Estimated cost, $800,000. J. C. Spofford, 36 Bromfield St., Archt.

Mass., New Bedford—N. Joseph, 1910 Purchase St., is building a 1 story, 47 x 100 ft. garage on Clark St. Estimated cost, $10,000.

MIDDLE ATLANTIC STATES

N. J., Florence—The Florence Pipe Fdry. & Machine Co. plans to build a 1 story, 50 x 100 ft. pattern shop.

N. J., Newark—The Mennen Co., 345 Central Ave., has had plans prepared for the construction of a 1½ story, 75 x 114 ft. garage and warehouse at 81 Orange St. Estimated cost, $30,000. Private plans.

N. J., Trenton—Kuhn & Jacob Machine & Tool Co., 28 Wood St., plans to build a 1 story, 30 x 50 ft. machine shop on Pennsylvania Ave. Estimated cost, $10,000. R. A. Schumann, 932 Lambert St., Engr.

N. Y., Granville—The Telescope Cot Bed Co., Inc., 535 West 79th St., New York City, will soon award the contract for the construction of a 1 story, 200 x 300 ft. factory and boiler house, here. Estimated cost, $100,000. R. G. Cory, 50 Church St., New York City, Archt. and Engr.

N. Y., New York (Borough of Manhattan)—M. G. W. Realty Co., 277 Bway., will build a 2 story, 100 x 100 ft. garage on 1st Ave. and 30th St. Estimated cost, $50,000.

N. Y., Watertown—The T. N. C. Motor Sales Co. plans to build a 2 story garage and sales station on Washington St. Estimated cost, $80,000 to $100,000.

Pa., Philadelphia—The Amer. Eng. Co., Wheatsheaf Lane and Sepviva St., has awarded the contract for the construction of a 1 story, 50 x 100 ft. foundry and machine shop. Estimated cost, $25,000. Private plans.

Pa., Philadelphia—City Transit, 1211 Chestnut St., will soon award the contract for the construction of an inspection shop at Bridge St. yard, for Frankford "L."

Pa., Philadelphia—A. Mignatti, 321 Duncannon St., is having plans prepared for the construction of a 1 story, 100 x 125 ft. garage on Clarkson and 2d Sts. Estimated cost, $20,000. E. A. Wilson, 1208 Chestnut St., Archt.

Pa., Philadelphia—H. T. Potts & Co., Inc., 316 North 3d St., has awarded the contract for the construction of a 1 story foundry on D and Erie Sts. Estimated cost, $15,000.

Pa., Pittsburgh—The Pittsburgh Malleable Iron Co. will soon award the contract for the construction of a 2 story, 54 x 100 ft. factory, on 35th St. and Spruce Ave. Estimated cost, between $20,000 and $25,000. P. Dietz, House Bldg., Archt. and Engr.

MIDDLE WEST STATES

Ill., Chicago—The Miles Piston Ring Co., c/o W. G. Uffendell, Archt., 39 South La Salle St., has awarded the contract for the construction of a 1 and 2 story, 98 x 161 ft. piston ring factory at 5345-5353 South State St. Estimated cost, $60,000.

Mich., Adrian—The Michigan Wire Fence Co. is building a 50 x 60 ft. plant for the manufacture of wire fencing.

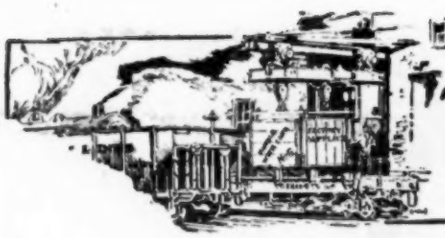
Mich., Detroit—O. L. Buler, 760 Chene St., has awarded the contract for the construction of a 1 story, 50 x 100 ft. garage. Estimated cost, $14,000. Private plans.

O., Cleveland—M. B. Abrams, Society for Savings Bldg., plans to build a 1 story, 70 x 100 ft. garage on East 152d St. and St. Clair Ave. Estimated cost, $40,000. Private plans.

O., Cleveland—The Center Garage Co., c/o H. Emerich, 15205 St. Clair Ave., is having plans prepared for the construction of a 1 story, 50 x 150 ft. garage on St. Clair and Holmes Aves. Estimated cost, $60,000. H. W. Steffens, 1029 Williamson Bldg., Archt.

O., Cleveland—A. Horwitz, 301 Society for Savings Bldg., will soon award the contract for the construction of a 1 story 90 x 110 ft. garage on Carnegie Ave. Estimated cost, $40,000. R. B. Aley, 764 East 103d St., Archt.

O., Cleveland—F. Ziehm & Sons, 6016 St. Clair Ave., plan to build a 1 story garage. Estimated cost, $15,000. Private plans.



THE WEEKLY PRICE GUIDE

IRON AND STEEL

PIG IRON—Quotations compiled by The Matthew Addy Co.:

CINCINNATI	Current	One Year Ago
No. 2 Southern	$44 50	$36.60
Northern Basic	40 00	34.00
Southern Ohio No. 2	42.00	36.55
NEW YORK—Tidewater Delivery		
2X Virginia (Silicon 2.25 to 2.75)	51.26	39.40
Southern No. 2 (Silicon 2.25 to 2.75)	48.26	41.40
BIRMINGHAM		
No. 2 Foundry	40.50	33.00
PHILADELPHIA		
Eastern Pa., No. 2x, 2.25-2.75 sil.	42 50	38.10
Virginia No. 2	46 25	39.10
Basic	38 25	34.60
Grey Forge	40.25	34.60
CHICAGO		
No. 2 Foundry local	40 00	36.25
No. 2 Foundry, Southern	46.66	38.00
PITTSBURGH, Including Freight Charge from Valley		
No. 2 Foundry	41 96	28.15
Basic	38 00	34.40
Bessemer	38.00	35.40

* F.o.b. furnace. † Delivered.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Current	One Month Ago	One Year Ago	Current	One Year Ago	Current	One Year Ago
Structural shapes	$3 80	$3 80	$3.47	$3.58	$3.62	$3.58	$3.47
Soft steel bars	3 70	3 70	3.52	3.34	3.52	3.48	3.52
Soft steel bar shapes	3.70	3 70	3.52	3.48	5.50	3.48	3.52
Soft steel bands	4.65	4 65	4.22	6.25			
Plates, ¼ to 1 in. thick	4.00	4.00	3.67	3.78	3.82	3.78	3.67

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Current	One Year Ago
Mill, Pittsburgh	$4.25	$3.50
Warehouse, New York	4.75	3.52
Warehouse, Cleveland	3.52	3.42
Warehouse, Chicago	4.12	3.52

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the base quotations from mill:

Blue Annealed	Large Mill Lots Pittsburgh	New York Current	New York One Year Ago	Cleveland	Chicago
No. 10	3.55	4 90	5.50–6 00	5.00	4 68
No. 12	3.60	4 95	5.56	5.05	4 83
No. 14	3.65	5 00	5 92	5.10	5 03
No. 16	3.75	5 10	6.02	5.20	5 13
Black					
Nos. 18 and 20	4.20	5 80	6 80–7 80	5 60	5 80
Nos. 22 and 24	4.25	5 85	6 85–7 85	5 75	5 85
No. 26	4.30	5 90	6 90–7 90	5 80	5 90
No. 28	4.35	6 00	7 00–8 00	5 90	6 00
Galvanized					
No. 10	4 70	6 40	6 50	6 25	5 30
No. 12	4 80	6 50	6 60	6 35	5 40
No. 14	4 80	6 50	6 60	6 35	5 40
Nos. 18 and 20	5.10	6 75	6 90	6 65	5 70
Nos. 22 and 24	5.25	6 90	7 05	6 80	5 85
No. 26	5.40	7 05	7 20	6 95	5 90
No. 28	5.70	7.35	7.50–9.00	7 25	6.00

COLD FINISHED STEEL—Warehouse prices are as follows:

	New York	Chicago	Cleveland
Round shafting or screw stock, per 100 lb. base	$5.50	$5.80	$4.84
Flats, square and hexagons, per 100 lb. base	6.00	6.30	5 34

DRILL ROD—Discounts from list price are as follows at the places named:

	Per Cent.
New York	50
Cleveland	50
Chicago	50

NICKEL AND MONEL METAL—Base prices in cents per pound any quantities, f.o.b. Bayonne, N. J.

	Nickel	Monel Metal		
Ingot and shot	43	Shot and blocks	35	Hot rolled rods (base) 42
Electrolytic	45	Ingots	38	Cold rolled rods (base) 50
		Sheet bars	40	Hot rolled sheets (base) 55

Special Nickel and Alloys

Malleable nickel ingots	45
Malleable nickel sheet bars	47
Hot rolled rods, Grades "A" and "C" (base)	60
Cold drawn rods, grades "A" and "C" (base)	72
Copper nickel ingots	42
Hot rolled copper nickel rods (base)	52
Manganese nickel hot rolled (base) rods "D" — low manganese	64
Manganese nickel hot rolled (base) rods "D"— high manganese	67

Domestic Welding Material (Swedish Analysis)—Welding wire in 100-lb lots sells as follows, f. o.b. New York: 5/32, 8½c. per lb.; ¼, 8c.; 5/16 to ½, 7½c Domestic iron sells at 1 2c. per lb.

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Current	Cleveland Current	Chicago Current
Openhearth spring steel (heavy)	7.00	8.00	9.00
Spring steel (light)	10.00	7.00	12.00
Coppered bessemer rods	9.00	8.00	7.00
Hoop steel	4.65	4.04	4.43
Cold-rolled strip steel	9.50	8.25	9.25
Floor plates	5.75	4.00	6.28

WROUGHT PIPE—The following discounts are to jobbers for carload lots on the Pittsburgh basing card:

BUTT WELD

Inches	Steel Black	Steel Galvanized	Inches	Iron Black	Iron Galvanized
¼ to 3	54–57½%	41½–44%	⅜	15½–25½%	+1½–11½%
			½	19½–29½%	1½–11½%
			¾ to 1½	24½–34½%	8 –18½%

LAP WELD

2	47 –50½%	34½–38%	1¼		
2½ to 6	50 –53½%	37½–41%	1½		
7 to 12	47 –50½%	33½–37%	2	20½–28½%	6½–14½%
13 to 14	37½–41 %		4½ to 6	22½–30½%	9½–17½%
15	35 –38½%		2½ to 4	22½–30½%	9½–17½%
			7 to 12	19½–27½%	6½–14½%

BUTT WELD, EXTRA STRONG PLAIN ENDS

¼ to 1¼	52 –55½%	39½–43%	⅜ to 1½	24½–34½%	9½–19½%
2 to 3	53 –56½%	40½–44%			

LAP WELD, EXTRA STRONG PLAIN ENDS

2	45 –48½%	33½–37%	1¼		
2½ to 4	48 –51½%	36½–40%	1½		
4½ to 6	47 –50½%	35½–39%	2	21½–29½%	8½–16½%
7 to 8	43 –46½%	29½–33%	2½ to 4	23½–31½%	11½–19½%
9 to 12	38 –41½%	24½–28%	4½ to 6	22½–30½%	10½–18½%
			7 to 8	14½–22½%	2½–10½%
			9 to 12	9½–17½%	5½–13½%

Warehouse discounts as follows:

	New York Black	New York Galv.	Cleveland Black	Cleveland Galv	Chicago Black	Chicago Galv.
¼ to 3 in. steel butt welded	38%	22%	42%	39%	57½%	44%
2½ to 6 in. steel lap welded	33%	18%	44%	29%	53½%	41%

Malleable fittings. Classes B and C, banded, from New York stock sell at plus 45%. Cast iron, standard sizes, plus 5%.

METALS

MISCELLANEOUS METALS—Present and past New York jobbers' quotations in cents per pound, in quantities up to car lots:

	Current	Month Ago	Year Ago
Copper, electrolytic	15.00	15.00	19 00
Tin in 5-ton lots	34 25	35 25	59 00
Lead	5 375	5 75	7 875
Zinc	7.00	7 00	9 25
ST. LOUIS			
Lead	5.25	6.25	7 50
Zinc	6.75	6.75	8 875

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	New York Current	New York Month Ago	New York Year Ago	Cleveland Current	Cleveland Year Ago	Chicago Current	Chicago Year Ago
Copper sheets, base	21.50	22.50	28.50	22.50	29.50	26.50	35.00
Copper wire (carload lots)	17.00	17.00	28 00	20 00	28 50	24 00	26 00
Brass sheets	20 25	20 25	25 50	23 00	28 00	30 00	26 00
Brass pipe	25.00	25.00	30 50	25 00	34 00	23.25	37 00
Solder (half and half) (case lots)	27.75	27.25	35.00	29.00	35.90	21.00	38 50

Copper sheets quoted above hot rolled 24 oz., cold rolled 14 oz. and heavier, add 2c.; polished takes 5c. per sq.ft. extra for 20-in. widths and under; over 20 in., 7½c.

BRASS RODS—The following quotations are for large lots, mill. 1000 lb. and over, warehouse; net extra:

	Current	One Year Ago
Mill	18.25	22.75
New York	18 25	24 00
Cleveland	21 00	28 00
Chicago	21 25	25 00

SHOP MATERIALS AND SUPPLIES

ZINC SHEETS—The following prices in cents per pound are f.o.b. mill—less 8% for carload lots 11.50

	Warehouse			
	—In Casks—		— Broken Lots —	
	Current	One Year Ago	Current	One Year Ago
Cleveland	15.30	11.50	14.70	12.00
New York	14.00	13.00	14.50	13.50
Chicago	14.50	15.00	14.95	15.00

ANTIMONY—Chinese and Japanese brands in cents per pound, in ton lots for spot delivery, duty paid:

	Current	One Year Ago
New York	6.25	9.50–9.75
Chicago	6.25	10.00
Cleveland	7.50	11.625

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

	*New York			
	Current	One Year Ago	Cleveland	Chicago
Copper, heavy, and crucible	12.00	18.00	10.00	10.50
Copper, heavy, and wire	11.50	17.50	9.50	10.00
Copper, light, and bottoms	10.00	15.75	9.00	9.00
Lead, heavy	4.00	7.00	4.00	4.00
Lead, tea	3.00	5.00	3.00	3.50
Brass, heavy	7.00	9.00	7.00	10.00
Brass, light	5.50	8.00	5.00	5.50
No. 1 yellow brass turnings	6.50	9.50	5.50	5.50
Zinc	4.50	6.75	3.00	4.25

*These prices nominal because of dull market

ALUMINUM—The following prices are from warehouse at places named:

	New York	Cleveland	Chicago
No. 1 aluminum, 98 to 99% pure, in ingots for remelting (1-15 ton lots), per lb	29.00	26.00	33.50

COPPER BARS—From warehouse sell as follows in cents per pound, for ton lots and over:

	Current	One Year Ago
New York (round)	28.00	34.00
Chicago	24.50	28.00
Cleveland	23.00	31.00

BABBITT METAL—Warehouse price per pound:

	—New York—		—Cleveland—		— Chicago —	
	Current	One Year Ago	Current	One Year Ago	Current	One Year Ago
Best grade	70.00	90.00	53.00	68.50	40.00	60.00
Commercial	30.00	50.00	14.50	17.25	9.00	13.00

NOTE—Price of babbitt metal is governed largely by formula, no two manufacturers quoting the same prices. For example, in New York we quote the best two grades, although lower grades may be obtained at from 16.00 to 20.00

SHOP SUPPLIES

NUTS—From warehouse at the places named, on fair-sized orders, the following amount is deducted from list:

	—New York—		— Cleveland —		— Chicago —	
	Current	One Year Ago	Current	One Year Ago	Current	One Year Ago
Hot pressed square	+$1.25	List	List net	$1.00	+1.15	1.45
Hot pressed hexagon	+ 1.25	List	List net	1.00	+1.15	1.45
Cold punched hexagon	+ 1.25	List	List net	1.00	+1.15	1.05
Cold punched square	+ 1.25	List	List net	1.00	+1.15	1.05

Semi-finished nuts, ⅞ and smaller, sell at the following discounts from list price:

	Current	One Year Ago
New York	30%	70-5%
Chicago	40%	50%
Cleveland	50%	60–10%

MACHINE BOLTS—Warehouse discounts in the following cities:

	New York	Cleveland	Chicago
½ by 4 in. and smaller	35%	50%	40%
Larger and longer up to 1¼ in. by 30 in.	25%	40%	30%

WASHERS—From warehouses at the places named the following amount is deducted from list price:

For wrought-iron washers:

New York..... $2.00 Cleveland..... $2.75 Chicago..... $2.50

For cast-iron washers, ⅜ and larger, the base price per 100 lb. is as follows:

New York..... $7.00 Cleveland..... $4.50 Chicago..... $5.50

CARRIAGE BOLTS—From warehouses at the places named the following discounts from list are in effect:

	New York	Cleveland	Chicago
½ by 6 in. and smaller	+ 20%	40%	25%
Larger and longer up to 1 in. by 30 in.	+ 20%	35%	25%

COPPER RIVETS AND BURS sell at the following rate from warehouse:

	Rivets		Burs	
	Current	One Year Ago	Current	One Year Ago
Cleveland	25%	30%	10%	30%
Chicago	net	20%	net	20%
New York	40%–5%	30%	net	10%

RIVETS—The following quotations are allowed for fair-sized orders from warehouse:

	New York	Cleveland	Chicago
Steel ⅞ and smaller	35%	50%	30%
Tinned	35%	50%	30%

Structural, same sizes:

New York..... $5.50 Chicago..... $5.73 Pittsburgh..... $4.50

Boiler, ⅜, ½, 1 in. diameter by 2 to 5 in. sell as follows per 100 lb.:

New York..... $6.00 Chicago..... $5.83 Pittsburgh..... $4.60

MISCELLANEOUS

SEAMLESS DRAWN TUBING—The base price in cents per pound from warehouse in 100-lb. lots is as follows:

	New York	Cleveland	Chicago
Copper	25.00	28.00	29.00
Brass	24.00	25.00	28.00

Prices vary with the quantity purchased. For lots of less than 100 lb., but not less than 75 lb., the advance is 1 c.; for lots of less than 75 lb., but not less than 50 lb., 2½c. over base (100-lb. lots); less than 50 lb., but not less than 25 lb., 5c. should be added to base price; quantities less than 25 lb. add 10c per lb.

Double above extras will be charged for angles, channels and sheet metal mouldings if ordered in above quantities. Above extras also apply to brass rod other than standard stock sizes—stock sizes being considered as ⅛-2 in. inclusive in rounds, and ⅛-1½ in., inclusive, in square and hexagon—all varying by thirty seconds up to 1 in. by sixteenths over 1 in. On shipments aggregating less than 100 lb., there is usually a boxing charge of $1.50.

LONG TERNE PLATE—In Chicago No. 28 primes from stock sell, nominally, for $7.60 per 100 lbs.

In Cleveland—$10 per 100 lbs.

COTTON WASTE—The following prices are in cents per pound:

	New York			
	Current	One Year Ago	Cleveland	Chicago
White	13.00@15.00	13.00	15.00	15.00@17.00
Colored mixed	7.00@12.00	9.00–12.00	11.00	11.00@13.00

WIPING CLOTHS—Jobbers' price per 1000 is as follows:

	13½x13½	13½x20½
Cleveland	55.00	65.00
Chicago	41.00	43.50

SAL SODA sells as follows per 100 lb.:

	Current	One Month Ago	One Year Ago
New York	$2.00	$2.00	$2.25
Philadelphia	2.75	2.75	2.00
Cleveland	4.00	3.00	2.50
Chicago	2.25	2.75	2.00

ROLL SULPHUR in 360-lb. bbl. sells as follows per 100 lb.:

	Current	One Month Ago	One Year Ago
New York	$3.50	$3.50	$3.40
Philadelphia	3.65	3.65	4.625
Chicago	4.00	3.85	4.125

COKE—The following are prices per net ton at ovens, Connellsville:

	Current	One Month Ago	One Year Ago
Prompt furnace	$5.00@$5.50	$6.00@$7.00	$6.00@$7.00
Prompt foundry	6.25@7.00	7.00@8.00	6.00@7.00

FIRE CLAY—The following prices prevail:

		Current
Ottawa, bulk in carloads	Per Ton	$8.00
Cleveland	100-lb. bag	1.00

LINSEED OIL—These prices are per gallon:

	—New York—		—Cleveland—		—Chicago—	
	Current	One Year Ago	Current	One Year Ago	Current	One Year Ago
Raw in barrels, (5 bbl. lots)	$0.83	$1.90	$1.05	$2.00	$0.97	$1.77
5-gal cans	0.90	2.10	1.30	2.25	1.22	1.97
1-gal cans (6 to case)	1.05	.....	.....	.....	.....	.....

WHITE AND RED LEAD—Base price per pound:

	Red				White			
	Current		One Year Ago		Current		One Year Ago	
	Dry	In Oil	Dry	In Oil	Dry and In Oil		Dry and In Oil	
100 lb. keg	14.00	15.50	14.50	15.50	14.00	14.50	14.00	14.50
25 and 50-lb. kegs	14.25	15.75	14.75	15.75	14.25	14.75	14.25	14.75
12½-lb. keg	14.50	16.00	15.00	16.00	14.50	15.00	14.50	15.00
5-lb. cans	17.00	18.50	15.00	17.50	17.00	16.50	17.00	16.50
1-lb. cans	19.00	20.50	16.00	18.50	19.00	17.50	19.00	17.50

500 lb. lots less 10% discount. 2,000 lb. lots less 10-4% discount. 10,000 lb. lots less 10-7½% discount.

O., Cleveland—V. Terrill, City Hall, plans to build a 2 story, 50 x 125 ft. garage on East 140th St. and Euclid Ave. Estimated cost, $50,000. Private plans.

Wis., Superior — The Clarkson Coal & Dock Co., Birch Ave. and Rices Point, Duluth, has had plans prepared for the construction of a 2 story machine shop and office building, here. Estimated cost, $45,000. R. C. Buck, U. S. Natl. Bank Bldg., Archt.

Wis., Wisconsin Rapids—The Amer. Rotary Engine Co. is having plans prepared for the construction of a 1 story, 60 x 120 ft. factory. Estimated cost, $20,000. La Salle Eng. Co., 337 West Madison St., Chicago, Engrs.

WEST OF THE MISSISSIPPI

Ia., Des Moines—The Keith Furnace Co., c/o R. S. Keith, 326 11th St. S. W., is having plans prepared for the construction of a 1 and 2 story factory, to include a foundry, etc., on East 26th St. and Dean Ave. Estimated cost, $55,000. Boyd & Moore, 1020 Grand Ave., Archts.

Minn., Montrose—W. Wandersee plans to build a 1 story, 50 x 90 ft. garage. Private plans.

N. D., Fargo—G. Schass has had plans prepared for the construction of a 2 story, 56 x 140 ft. garage on 4th St., N. W. F. Kurke, Archt.

N. D., Fargo—J. C. Vincent, 211 Northern Pacific Ave., plans to build a 4 story, 50 x 140 ft. garage on 3d St. and Northern Pacific Ave. Estimated cost, $90,000. Keith & Kurke, Equity Bldg., Archts.

N. D., Minot—The Great Northern Ry. Co., 175 East 4th St., St. Paul, Minn., plans to construct a roundhouse and repair shops here. Estimated cost, $100,000. A. H. Hogeland, ch. engr.

Tex., Childress—The Fort Worth & Denver City R.R., Denver Record Bldg., Ft. Worth, is having plans prepared for the construction of additions to its machine shops, etc., here. Estimated cost, $500,000. R. C. Goway, Denver, Ch. Engr.

WESTERN STATES

Cal., Gridley — The Friesley Aircraft Corp., Box 368, plans to build a plant for the manufacture of large passenger and freight airplanes. B. M. Spencer, Ch. Engr.

Cal., Los Angeles—P. L. Wilson & Co., 631 South Sprague St., will soon award the contract for the construction of a 1 story, 140 x 150 ft. garage, on Bonnie Brae and 7th Sts. Estimated cost, $40,000. Walker & Eisen, Hibernian Bldg., Archts. Noted Dec. 23.

CANADA

Ont., Ottawa — The Beach Fdry. Ltd., Broad St., is building a factory for the manufacture of stoves, ranges and furnaces. Estimated cost, $125,000. B. C. Beach, Pres.

General Manufacturing

NEW ENGLAND STATES

Conn., Danbury — The Beaver Brook Paper Mills, Inc., Beaver Brook St., plans to build a 1 story, 75 x 150 ft. addition to its manufacturing plant.

Conn., Stamford—The Huber Ice Cream Co., 800 Seaview Ave., Bridgeport, will build a 1 story, 40 x 100 ft. ice cream plant on Shippan Ave. Estimated cost, $20,000.

Mass., Leominster — The Viscoloid Co. will build a 1 story, 20 x 95 ft. addition to its plant, for the manufacture of viscoloid sheeting. Estimated cost, $10,000.

Mass., North Adams — The Trojan Ice Cream Co., 276 5th Ave., Troy N. Y., is having plans prepared for the construction of a 2 story, 40 x 50 ft. plant here. Estimated cost, $60,000. E. J. Clark, Cannon Bldg., Troy, N. Y., Archt.

N. H., Manchester — The New England Iron & Metal Co. plans to build a 5 story, 25 x 125 ft. manufacturing plant.

MIDDLE ATLANTIC STATES

Md., Baltimore — The Coconut Products Co., 708 Amer. Bldg., plans to build a 1 story addition to its refinery on 7th Ave. and 6th St. Estimated cost, $15,000. Private plans.

Md., Halpine — The International Shoe Heel Corp., Continental Trust Bldg., Washington, D. C., is having plans prepared for the construction of a 1 story, 40 x 500 ft. shoe factory. Estimated cost, $200,000.

N. J., Perth Amboy—The Barber Asphalt Paving Co. plans to build a plant on a 16 acre site. Estimated cost, $1,000,000.

Pa., Woodlawn — The Beaver Building Block Co., Box 832, is building a 60 x 100 ft. factory. Estimated cost, $30,000. Bontemps & Howard, Woodlawn, Engrs.

SOUTHERN STATES

Ala., Hallawkee—J. A. Allgood plans to rebuild its planing mill recently destroyed by fire. Estimated cost, $25,000.

Ky., Lexington — The Martin Constr. & Eng. Co. plans to build a refining plant to have a 150,000 bbl. capacity.

Ky., Louisville—The Natl. Candy Co., c/o Bradas & Gheens, 817 South Floyd St., has awarded the contract for the construction of a 5 story factory on a 135 x 220 ft. site on Bway between 14th and 15th Sts. Estimated cost, $600,000. Noted Dec. 9.

Tenn., Knoxville — The Knoxville Drug Club plans to build a plant for the manufacture of ice cream. D. M. Chambliss, Pres.

MIDDLE WEST STATES

Ind., Marion—The Standard Glass Co. plans to build a 1 story glass factory. Estimated cost, $75,000. Private plans.

Mich., Detroit—The Detroit Casket Co., 177 Congress St., is building a 2 or 3 story, 114 x 166 ft. addition to its factory on Ash St. between Grand River and Trumbull Aves. Estimated cost, $100,000.

Mich., Jackson — The Michigan State Prison plans to construct 2 and 3 story buildings, to include industrial works. Estimated cost, $5,000,000. H. L. Hulburt, Warden.

O., Cleveland—The Euclid Wood Products Co., Nottingham Rd., will build a 1 story, 36 x 100 ft. addition to its factory. Estimated cost, $10,000.

O., Cleveland—The Mireau Laundry Co., 2232 St. Clair Ave., plans to build a 2 story, 32 x 120 ft. addition to its factory at 2242 St. Clair Ave. Estimated cost, $25,000. Private plans.

Wis., Racine—Journal Printing Co., 338 Main St., will soon award the contract for the construction of a 2 story, 60 x 110 ft. office building and paper plant. Estimated cost, $125,000. F. R. Starbuck, Secy. L. Bassindale, 321 Capitol Bank Bldg., St. Paul, Minn., Archt.

WEST OF THE MISSISSIPPI

Kan., Wichita — The Concrete Products Co., Caldwell Murdock Bldg., plans to build a 2 story, 150 x 210 ft. cement plant and warehouse on Rock Island Ave. and 13th St. Estimated cost, $50,000. K. M. Baker, Secy.

Minn., Little Falls—The Hennepin Paper Co. plans to build a sulphite pulp plant. Estimated cost, $500,000.

Minn., South Hibbing—The Oliver Iron Mining Co., Wolvin Bldg., Duluth, is having plans prepared for the construction of a 1 story laundry. Estimated cost, $45,000. Private plans.

Okla., Henryetta—The Henryetta Oil & Refining Co. plans to improve its plant. Estimated cost, $50,000. C. Harrismen, Secy.

Okla., Lincolnville (Miami, P. O.)—Natl. Tripoli Co., Chamber of Commerce Bldg., Joplin, will soon award the contract for the construction of a 2 story factory, here. Estimated cost, $130,000.

CANADA

N. S., Hartville — Silliker, & McMann, Cragg Bldg., Halifax, plan to build a pulp and lumber mill along the St. Croix River, here. P. H. Moore, local mgr.

Ont., Chatham—The Excelsior Knitting Co. will receive bids until January 18 for the construction of a plant. Estimated cost, $60,000.

Ont., Cornwall—The Canadian Linoleum & Oil Cloth Co. plans to build a 2 story addition to its plant. Estimated cost, $35,000.

Ont., Frankford—The Canada Box-Board Co., Seigneurs St., Montreal, will receive bids in Feburary for the construction of a groundwood plant, here. Estimated cost, $300,000.

Ont., Port Arthur—Pigeon River Lumber Co. plans to construct a 1 and 2 story saw mill. Estimated cost, $50,000.

Que., Montmagny — Price Bros., 56 St. Peter St., Quebec, will receive bids in January for the construction of a sawmill here. Estimated cost, $85,000.

Que., Montreal East — The Royal Duke Oil Co., 157th and James Sts., Montreal, will soon award the contract for the construction of a factory and office building, here. Estimated cost, $50,000.

Que., Three Rivers—The Canadian International Paper Co. will receive bids until Feb. 1 for the construction of an addition to its sulphite mill. Estimated cost, $100,000.

"SEARCHLIGHT"

Business Opportunities
Employment Opportunities
Selling Opportunities, etc.

See Pages 193 to 216